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The Journal of HEREDITY

A monthly publication devoted to Plant Breeding Animal Breeding and Eugenics

THE MARTEN—A FUR FARMING POSSIBILITY

(See Page 449)

The Negro at Home and Abroad — **Chromosome-Mutants in Stocks**

NOVEMBER, 1927 — Vol. 18, No. 11

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The

Journal of Heredity

VOL. XVIII, No. 11 NOVEMBER, 1927

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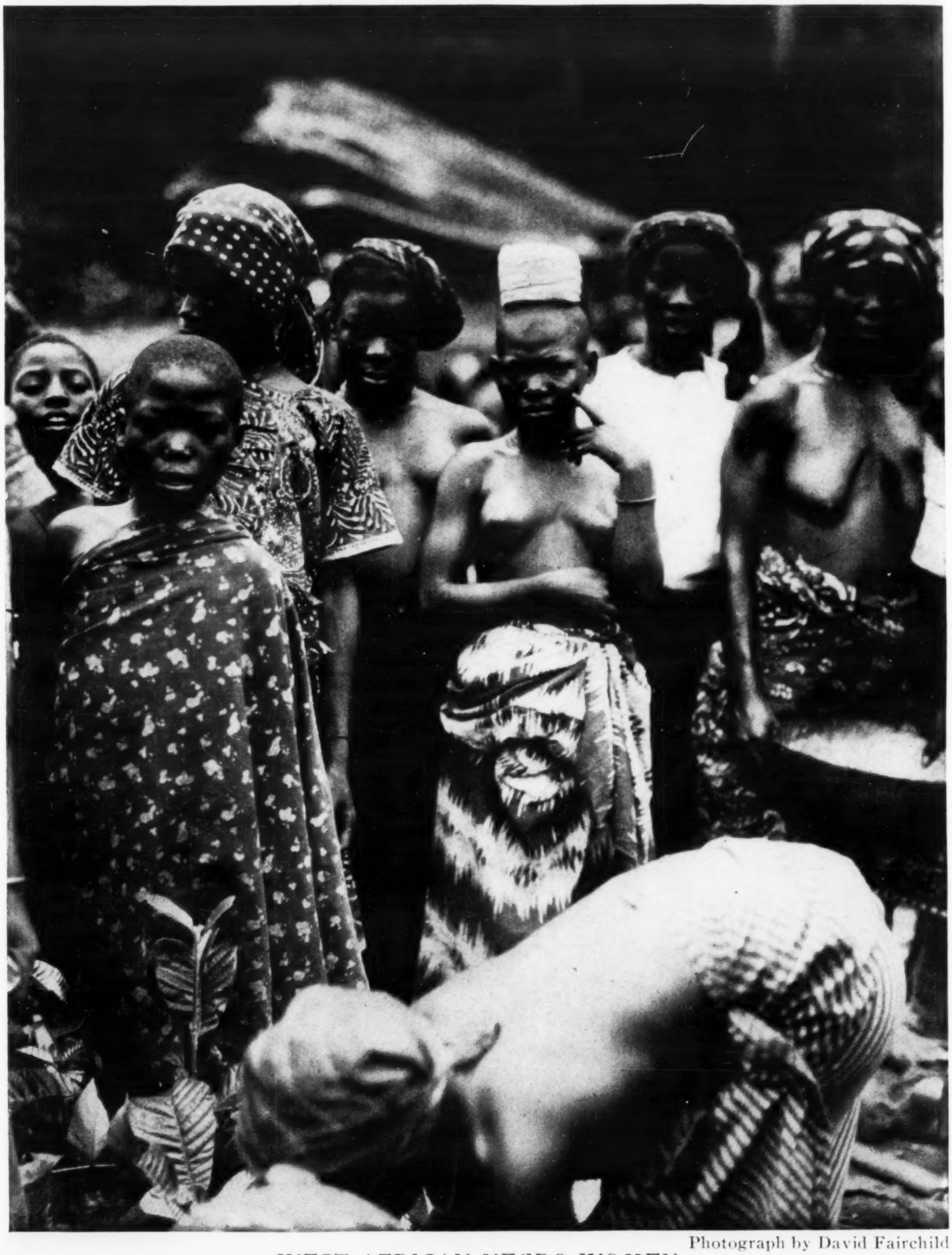
The JOURNAL OF HEREDITY is published monthly by the
AMERICAN GENETIC ASSOCIATION
At 1918-32 Harford Avenue, Baltimore, Md., and Victor Building, Washington, D. C.

Address communications regarding editorial matters and the business management of the Association to Room 306, Victor Building, Washington, D. C.

Entered as second class matter February 24, 1923, at the postoffice at Baltimore, Maryland. Acceptance for mailing at the special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized December 20, 1918. **Contents copyrighted 1927 by the American Genetic Association. Reproduction of articles or parts of articles permitted only upon request, for a proper purpose, and provided due credit is given to the author and to the JOURNAL OF HEREDITY, Washington, D. C.**

Date of Issue of this Number, January 11, 1928

$3.50 *a Year;* 35c *the Copy, for current numbers*

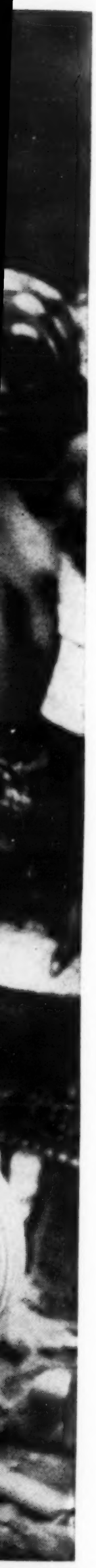


Photograph by David Fairchild

WEST AFRICAN NEGRO WOMEN

Frontispiece

Scene in a Women's Market at Asebu on the Gold Coast. It is interesting to reflect that some of these women are in all probability blood relatives of negroes who are living in America today. Their common ancestors were perfectly familiar with slavery long before the first slave ship anchored off the coast. Today the individual negro of West Africa is only free in a limited sense from the oppression of the chiefs.



airchild

AMERICAN RACE PROBLEMS

Studies in America and Africa Lead to Conflicting Conclusions—Race Crossing and Racial Justice

TWO important works* have appeared that will be read with profit and used for reference by all who are trying to understand these difficult and long-controverted questions of racial characters and reactions. The effort of both authors has been to study the basic facts of the race problems and to make their results accessible to other students and investigators. Readers should not allow themselves to be prejudiced prematurely by the fact that the books are written by advocates for the negro. Without a friendly and constructive interest, it would not be possible to learn enough about the negro to treat his case fairly.

The books that have been written against the negro certainly are no better than those that have been written in his behalf, from the standpoint of recognition of facts and constructive understanding. It is plain that the authors of these books have made their best effort to see the negro as he is, not as they might wish to have him in the future. They are zealous to place in the record any evidence or claim of ability or character of which a future for the negro may be made, but with no wish to deceive themselves or others by admitting spurious hopes or enthusiams.

The books supplement each other to a remarkable extent, one being a survey of the negro in Africa, the other an account of the American negro. It may be considered as the worst defect of both books that each shows only a limited and somewhat casual interest in the other's field of work. The writer on Africa refers incidentally to the "vitiated racial atmosphere of the Southern States of America," while the African background of the race is not familiar to the monographer of the American negro. The roots of the race problem lie in Africa, but some of its branches have grown much longer in America, and show the kind of fruit that must be expected in the other parts of the world. The reader of both books will be in a position to protect himself from many partial views, that might otherwise be misleading.

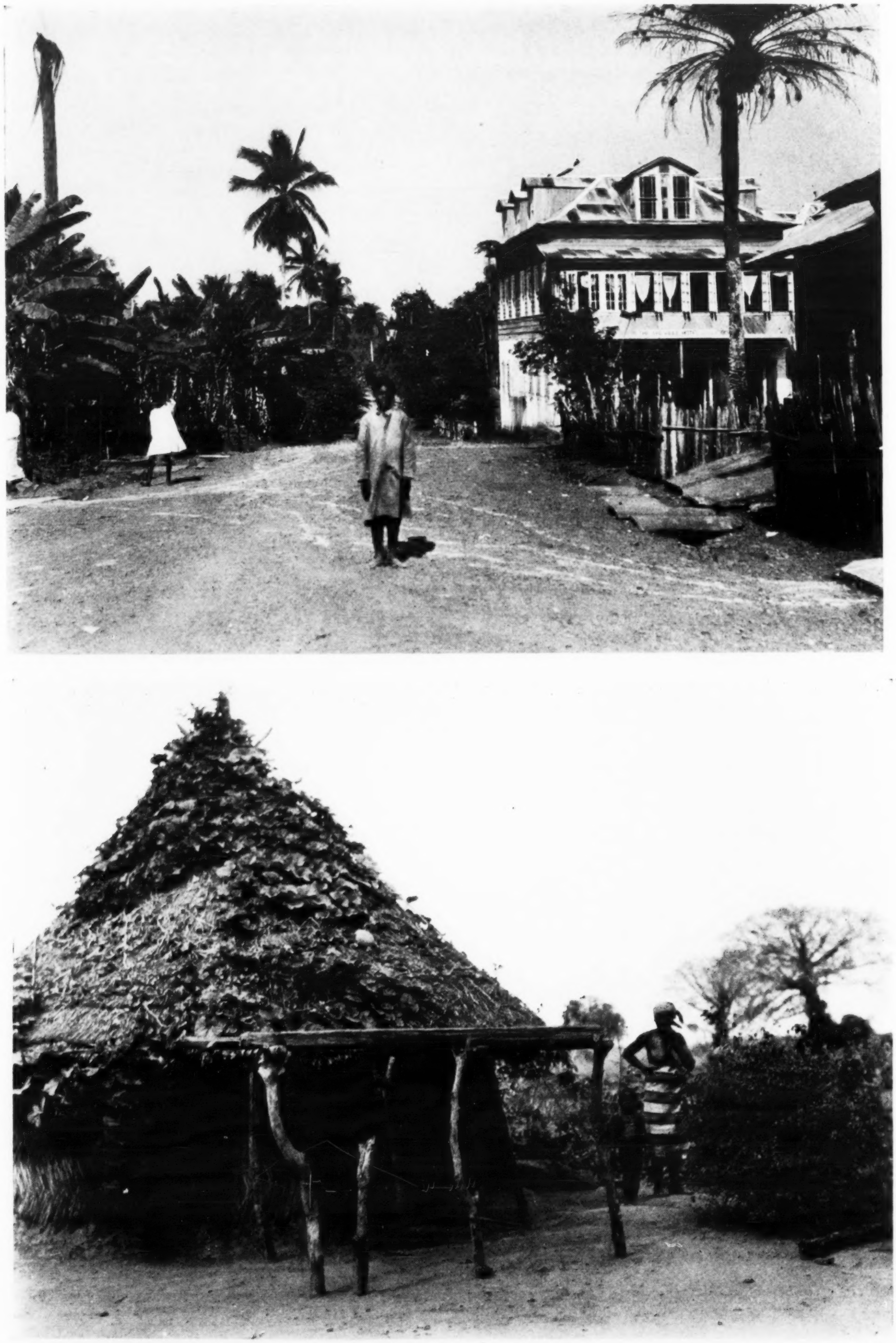
Race Crossing A Specious "Solution"

It seems remarkable that the centuries of intimate contacts between Africans and Europeans should not have yielded more definite knowledge, that could lead to practical solutions regarding the relations and future development of the races, but it has to be recognized that we are only at the beginning of an application of scientific facts and scientific methods to the study of these problems. Both of the books are scientific in the sense that the authors have tried to take account of all of the scientific data that have been collected in relation to the negro; yet the books were written under the dominance of unscientific ideas of the primary facts of the whole subject, the nature of the differences of race. The race problems are essentially biological, since it is only through biology that the nature of the race differences can be understood.

It gets us nowhere to debate the question whether Africans and Europeans should be considered as distinct

*RACE PROBLEMS IN THE NEW AFRICA, by the Rev. W. C. WILLOUGHBY, Professor of Missions in Africa, in the Kennedy School of Missions, Hartford, Conn. A study of the relation of Bantu and Britons in those parts of Africa which are under British control. Pp. 294. $4.50. Oxford, Clarendon Press, 1923.

THE AMERICAN RACE PROBLEM, a study of the negro by EDWARD BYRON REUTER, Professor of Sociology in the University of Iowa. $2.75, postage extra. Pp. xii+448. Thomas Y. Crowell Company, Publishers, New York. Copyright 1927.



Photographs by David Fairchild

AN "EUROPEAN" HOTEL AND A NATIVE HUT IN WEST AFRICA

Figure 1

It would be hard to imagine anything more unsightly than the pretentious so called "European Architecture" of West Africa with its corrugated iron roofs, rusting in patches. The native huts with their thatched roofs and mud walls are not only better suited to the climate but they show a sense of proportion and charm of construction which is in harmony with the life of the people. Upper photograph in Sierra Leone; lower, in British Gambia.

species of Homo, or classified merely as varieties of *Homo sapiens*. The race differences are not disposed of or reduced in any way by agreeing or disagreeing with a formal classification. The question of separate species does not turn on the account of difference, but on the constancy of characters or the existence of definite breaks in the series. Every biologist is aware of the existence of varied, diversified species showing wide differences of form and structure that would distinguish many species, or even genera, if differences of the same extent were shown as constant characters.

The characters of the human races and varieties certainly are not constant, and any breaks in the series that may have existed in former times by virtue of geographic isolation, are soon bridged over when propinquity is established. For biological purposes any progeny of diverse parents is considered as a hybrid, and it is recognized that hybrids of diverse stocks are likely to produce abnormalities. Hybrid races produced by the crossing of widely divergent stocks have not developed in the past, and are not to be expected in the future. Though neither of our authors argues for race mixture as a solution of race problems, both take it for granted that the race mixing will continue and that an ultimate fusion will occur, which will obliterate the lines of tension between the races.

> Russia has recently given us a striking illustration of the truth that the higher section of a society must lift the lower or be dragged down to its level. There is no promise of permanence in a society in which Black bondsmen hopelessly and increasingly preponderate over their White masters. No scientific frontiers protect the culture of a race that is intimately associated with another. History has much to tell of superior people who were depraved by their inferiors. Permanence can be assured only by fusing the two races into one homogeneous community. The Whites must either gradually lift the Blacks to their own level, incorporating them, as they become fit, into their own community, on what must ultimately become terms of equality; or they must suffer such a debasement of ideal from long and intimate association with a barbarous people that the community becomes homogeneous on a much lower plane. (Willoughby.)

This may seem a very strong argument from the missionary standpoint, that the blacks must be lifted up so that the expected fusion can take place on a high plane, but it is an argument that overlooks the most pertinent facts, both social and biological. There is no prospect that people who are on a high plane of intelligence and responsibility will engage in race mixing since they will not condemn their children to the difficult and equivocal status of racial hybrids. A biological outlook for a "high plane" racial fusion is equally lacking, because the effects of selection are lost when crossing takes place. There is no biological assurance of such an experiment being successful, even if it could be tried. Hybrids often show no inheritance of the effects of careful selection, but revert to the characters of remote ancestors.

A statement of the same idea of ultimate racial fusion has a prominent place as the last paragraph in Doctor Reuter's book, though the idea is not supported by any direct evidence or discussion in the body of the work.

> As a result of intermixture the Negroes as such ultimately will disappear from the population and the race problem will be solved. But in the meanwhile there will be the problem of defining relations in terms tolerable to the members of each racial group. (Reuter, p. 434.)

Perhaps it was considered self-evident that mixing eventually would have this effect, though even that assumption does not have facts to support it. The time may come when all of the negroes will have an admixture of white blood, but race tension may not be relaxed. History has shown in repeated instances that race conflicts are not relieved but rather are intensified by the existence of a mixed, interracial group. The reasons no doubt are partly social, but may also have a biological basis in the characters of hybrid populations. The diversities of hybrids are not limited to different combinations and intermediate stages between the

Photograph by David Fairchild

ENTRANCE STAIRWAY TO MONROVIA, THE CAPITOL OF LIBERIA

Figure 2

The unfinished character of the shacks on either side of the irregular broken down stone steps is reminiscent of conditions which usually result when one race tries to adopt the architecture of another.

characters of the normal parental stocks. The perjugate hybrids (the second and later generations) often show extreme and abnormal characters which are extra-parental, or outside of the range of the parental groups. The extent to which such reactions occur in hybrids or crosses of different human stocks is not definitely known, but where stocks are as different as the African and European races, degeneration among the hybrids is to be expected.

Examples of good mulatto families, as mentioned by Willoughby, afford no basis for the idea of race mixing. The study of heredity has shown the reason why the first generation of a hybrid may be good, while the second and later generations may be abnormal. The first generation is formed by germ-cells of the parent stocks. The reactions that affect the reproductive protoplasm and cause the abnormality of the later generations, do not take place until the germ-cells of the first generation are formed, so that the visible results of the abnormal reactions do not appear till the second generation. This is one of the biological facts that writers on racial problems need to get straight. The facts of biology do not give us an outlook toward any satisfactory settlement of the race problems in the direction of mixing and fusing. All of the writing that has been done on these assumptions may be passed by and dismissed.

In the future eugenic age it will be recognized as profoundly immoral to disregard the interests of our children and grandchildren, but it is only as the

Photograph by David Fairchild

LASTING EUROPEAN INFLUENCE IN WEST AFRICA

Figure 3

The swept dooryards and neatly trimmed hibiscus hedges of the villages back of Duala are in striking contrast with the disorder and ugliness of the usual African village. How much the severe discipline of the Germans and the French has had to do with this would be very instructive to determine. It is now a decade since the Cameroons became a French Mandate.

facts of heredity are understood that parental responsibilities can be appreciated. The welfare of children is a better basis for a system of morality than rights of marital possession, which have figured so largely in the past. Even without an understanding of heredity, and apart from the social inhibitions that have been established in the United States, it begins to be seen in South Africa that a true ground of marriage does not exist between the races.

> The time may come when marriage between White and Black may be no more reprehensible than between blonde and brunette; but there must come first a great widening of the mental and spiritual horizons of Africans or else a great decadence of Europeans. Where such decadence has already made it possible for Whites to realize their poor ideal of marriage (if "marriage" it can be called) in unions with Black women, there can be no valid objection to making the man legally liable for the care of the wife whom he has chosen and the children whom he brings into the world. Public opinion should vent its wrath, not upon such of these Europeans as make an honourable attempt to meet the responsibilities which they incurred in a paroxysm of sex-intoxication, but upon those who lightly throw their own children into the maelstrom of a semi-barbaric community. (Willoughby, p. 249.)

Justice Between Races

The lack of a biological viewpoint no doubt is responsible for a frequent misplacement of the idea of justice in the discussion of race problems. A conviction of the equality of the races becomes established in the minds of many well-intentioned people, be-

cause they feel that an inequality would be unjust. They are not reconciled to the fact that the races are different, but wish to believe that all of the differences are superficial and accidental, because the races have lived under unequal conditions which should now be corrected, so that the underlying equality may be shown.

Another reason for maintaining the equality of races is to avoid justification for slavery or for exploitation of one race by another, a line of argument that was popular a century ago, but is no longer in repute. For three centuries it was believed to be a great service to the negro to take him out of African barbarism and place him in contact with Christianity and civilization. Eventually it was recognized that slavery was bad for the white race, whatever its advantages for the black.

The world has moved away from slavery, though many of its consequences are still with us, among them this carry-over of argument for equality and the claim that special consideration should be given to other races because the existing differences and disabilities are in the nature of an injustice which right-minded people should undertake to correct by special missionary and philanthropic effort. In this country it is urged that the injuries of slavery must be made good to the negro. In Africa it is presented as a test of Christianity, that it must demonstrate its ability as a universal religion by placing the Africans on the same footing of progress as the European race. It begins to be seen that the Africans are not the same as Europeans, but are different in many essentials that were overlooked in the past. The argument now is that in order to Christianize the Africans it is necessary to have a very thorough knowledge and understanding of their native languages, institutions, and ways of life.

Before a European can so present the Gospel to a tribesman that the latter may have an adequate knowledge of its august authority, profound value, and tremendous demands, he must not only be familiar with the Gospel, but with the tribesman. To the intellectual and spiritual equipment that is necessary for efficient ministry in the churches of the homeland, he must add years of special study of the language, lore, institutions, and life of the tribesman. He must obtain, somehow, an intimate knowledge of the tribesman's outlook on life—his possessions and aspirations—what he seeks, what he finds, and what he misses.

Now if we expose people who have always found their moral sanctions in religion to a variety of learning that has been emasculated of its spiritual significance, we do them wrong, and must expect to pay the penalty. Hence the call to the Church, She must give herself to the study of Bantu religion, law, and institutions, after the comparative method—a study, it may be remarked, which breaks down race-prejudice as few other things can do; and she must not only do her part in teaching the Bantu to evolve citizenship out of tribal solidarity, but must, at the same time, help the future leaders of that race to discover the true spiritual significance of life, revealing to them the greatness and glory of that for which their fathers dimly groped. She must help in the production of a balanced and orderly development of the whole man—spiritual, moral, and intellectual). (Willoughby, pp. 265 and 271.)

Considering the number and diversity of tribes, languages and customs in Africa, the proposed preparation of missionary workers would be an immense undertaking out of all proportion to anything that has been attempted in other parts of the world.

To ask more understanding and consideration for other races than we have given to our own, places us on false ground. We may have a professional zeal in the effort that we are making to advance another race, but to appreciate other races fairly, we must also appreciate our own race. Otherwise we are in no position to interpret one race to another, or even to convince another race that our interest is a genuine good will, not selfish or superstitious.

When our interest in other races is overdone and unnatural, there is a complete recoil. It is futile to tell intelligent negroes that the races are equal. It only convinces them that we are foolish white men who know

little about negroes. But stupid or ignorant negroes are sometimes led to believe that the races are equal, and that they should imitate the white race by showing more resentment for supposed injuries.

Loss of African Tradition

For any basic judgment on the character and progress of the negro in America, first-hand knowledge of West Africa is hardly to be dispensed with. Lack of such knowledge makes it possible for Dr. Reuter to draw many reflections on the deterioration of the African natives when they were forced into slavery.

> Their moral ideas and tribal customs could not stand the shock of the slave traffic. Their systems of control and education were useless. Their political ideas, never more than a somewhat vague sense of loyalty to the chief, were soon gone. The whole culture complex collapsed and was not and could not be transmitted to their children. In place of the destroyed values they quickly came into possession of the objective culture values of their conquerors. They learned the agricultural and household activities of the whites through systematic training; they acquired through imitation the superficial vices and mannerisms of their white associates.
>
> . . . . In the negro children of American birth and ancestry little or nothing distinctly African remained. They had no knowledge of the country, nor of African ways and culture.

Casting up this account, it would seem that only the superficial vices and mannerisms had replaced the moral ideas, education and control that had been taken away from the negro. One tries in vain to imagine what there is in the life of the West Africans that the writer would deplore as a "lost culture," if he knew what people are like in West Africa.

It is interesting to note the extreme divergence of our two authorities on this important point, of the value of the mental furniture of the native African, and the loss to our American negroes in leaving it behind. It happens that our authority on negroes in Africa has specialized particularly on the study of life and ideas of the natives. He is able to speak particularly of South Africa where the tribal systems and conventional controls were more highly developed than in West Africa, and were not disorganized by the slave trade. He describes the native system in detail, and insists that it must be thoroughly understood and appreciated by those who are to preach, teach or deal fairly with the natives, yet instead of featuring the "social heredity" of the natives as a valuable asset, he sees it as a great liability, and even as the cause of tension between the races.

> The fact is that this bias or conceit, which we dignify with the term "race-prejudice," is not due to bodily differences, but to unlikeness of outlook upon life, or, if the phrase be preferred, diversity of civilization. It is the social and historical element which separates the varieties of man—the wide divergence of ideal which is due to a difference of social heredity. The spiritual heritage that has come to us through home, school, public institutions, trade, industry, art, science, tradition, and religion is far above that which has come to Blacks through tribalism, ancestor-worship, magic, and the tradition of an isolated and stagnant past. Such terms as "colour bar" are due to the fact that colour is a rough and ready symbol of different hygienic, economic, moral, and educational standards. Habits of thought that have been inwoven in the native mind by untold centuries of magic, serfdom, and barbarism cannot be unravelled in a generation or two; and it is this old mental and moral warp that excites the aversion of Europeans. (Willoughby, p. 225.)

If this theory is correct, the mental and moral warp must remain in the mind of the negro, though the entire content of African traditions and customs was obliterated and replaced by an alien system. It seems that both writers are at sea, as well as at variance on this question. With the American negroes deprived of their native African "culture," it may be considered that a gigantic experiment was tried, and the results do not agreee with the assumptions of either of our present authors. There is nothing to indicate that the American negroes are any the worse by losing their "native culture." On the other hand, the theory of race prejudice

being due to different ideas or diversity of civilization finds no support.

The native of savage Africa lives in a world of fear. The fear instinct is highly developed, and the African race has used its intelligence chiefly in this direction of elaborating an imaginary world of terror. The race has more ability than it was able to apply, with this immense handicap of superstition.

Slavery an African Institution

Since our American negroes know nothing of Africa, teaching them to lament these imaginary "destroyed values" is one way of teaching a resentment which otherwise might not be felt, and for which there is no basis. It is a false and foolish teaching that the negro was "conquered" and enslaved by the white man. It should be recognized that slavery is a native African institution, and that the slave trade was supplied very largely through regular native channels.

Boys and girls are still to be bought in native communities in West Africa. If it is safe to do so, their relatives will offer them for sale. Boys who want to go with the white man may ask to be bought and taken to America. The people who started the slave trade have been dead for centuries, but if the blame is now to be assessed upon the races, the negroes must take their share. They should have all the facts of the case, and not be led to believe that their ancestors were captured by white raiders of peaceful villages on the shores of Africa. Much of the trade was supplied from people who were already slaves in Africa. Where native wars and raiding were stimulated to capture more slaves this was done by the natives who supplied the traders. These facts were not unknown to Dr. Reuter, who recognizes slavery as an African institution, though his most direct statement still squints quite visibly in the direction of making other races responsible, both in ancient and modern times.

The status of slavery lies well within the mores of the Negro races. In the ancient world they appear to have been reduced to slavery by every people with whom they came into contact, and the institution was usual in most of the African tribes. At the time of the African exploration it was generally prevalent except among the hunting tribes and there was a general inheritance of the slave status. The extent and nature of the system varied with different regions but the demand for slaves was active and the native economy and social order was kept more or less chronically deranged by the trading in captives and the raiding expeditions incident thereto. From the eighth century, the Arabs, incident to their trade relations with Africa, engaged in the capture, purchase, and distribution of African slaves. (Reuter, p. 3.)

The Africans, like other primitive people, had only two things to do with conquered or captured enemies. For people at that stage of development, the keeping or selling of slaves does not appear as a form of cruelty, but as more kindly than killing and eating their captives. Slaves are of no great use in a primitive community where there is little to do, and little difference in conditions of life between the slaves and the masters. Slavery becomes something different when two unequal races are brought together, one to do all the work, the other to claim all the satisfactions. The conditions of normal life and development are vitiated for both races, but especially for the group that has become parasitic. While the parasitic group tends to decline in ability and numbers for lack of developing activities and contacts, the subordinate group may be so trained, hardened and selected under its supposedly adverse conditions, that its abilities are gradually increased, and eventually its position may be changed.

The system of slavery that was established in the early colonial period in the West Indies was so severe that it soon destroyed the native Indians, but it did not destroy the negroes. On the contrary, the colonial parasites died out, while the negroes have flourished and occupied the islands. Nobody intended to annex the West Indies to

Africa, but the slave system worked out that way.

The same prospect was indicated for the southern States in the gradual growth of the "Black Belts," where the preponderance of negro population became so great that the white population gradually moved back. The outlook in the South may be changed in some districts by the withdrawal of many of the negroes from the rural districts to industrial pursuits in the towns, and by automobiles and good roads that reduce the isolation of the rural districts. A new solution of the problem has become possible by the negroes going to the cities and the white people staying in the country. It is too early for any confidence to be placed in that possibility, and neither of the present writers appears to have considered it, though even in South Africa there is said to be a tendency for the natives to become urbanized.

O. F. Cook.

While the readers of the *Journal* are familiar with Mr. Cook's writings on the general subject of evolution and on the special subject of plant breeding, there are only a few who are aware that he once spent five years in Liberia studying the problem of the education of the negro. Since that time he has been more or less constantly associated with widely different races of people in Guatemala, Mexico, Peru, Egypt, China, Japan, Palestine, Haiti, and Panama. The opinions presented here represent the mature reflections of a biologist who for over thirty years has studied the race question in our own South and in Africa. His active association with plant breeding experiments and his studies on evolution have given an exceptional opportunity to evaluate the importance of the laws of heredity in considering problems of race and race mixture.—*Editor.*

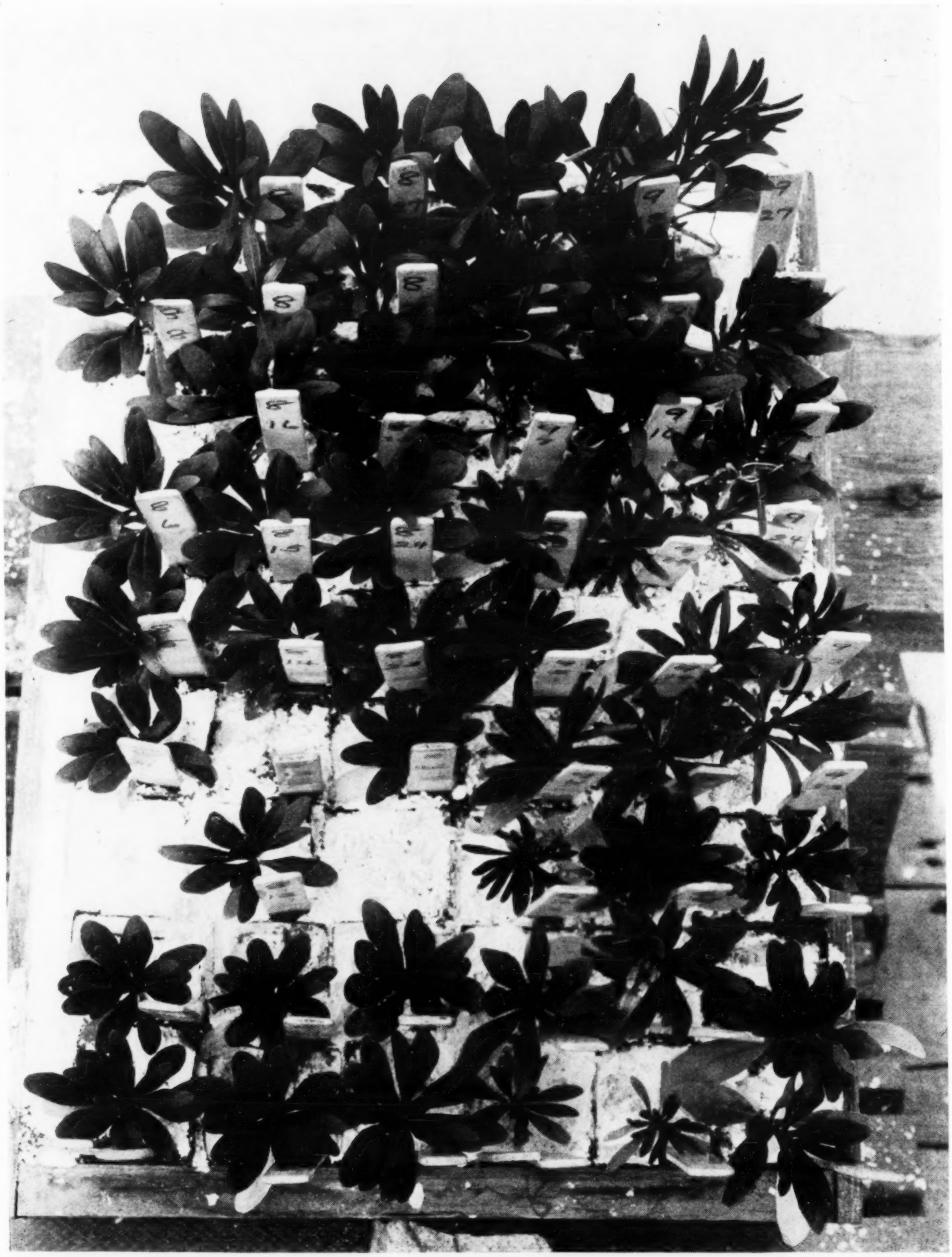
A New Edition of Babcock and Clausen's "Genetics"

GENETICS IN RELATION TO AGRICULTURE, New Second Edition, *by* E. B. BABCOCK and R. E. CLAUSEN. Pp. 623, price $5.00. McGraw-Hill Book Co., New York, 1926.

The complete revision of this standard text has brought it up-to-date. It should not be thought of as a revision in the usual meaning of the word but as an entirely new text written with a background of experience gained in writing the previous edition. Teachers, students and research workers are fortunate in having such a usable and valuable book, which can hardly be too highly praised.

The reviewer welcomes especially in the chapter on Clonal Selection the interpretation given to recent work in this field of genetics, but wonders, however, if bud variations are so much more frequent in some kinds of plants than in others as the authors would lead us to think. Perhaps instead our view is restricted because of the narrow range of plant material commonly dealt with. Possibly all the kinds of variations found in citrus will be found in pyrus, rubus and other groups and, if the same kind of material in each group were studied, the same kinds and frequency of bud variations would be found.

G. M. D.



PROGENY OF NORMAL AND SLENDER STOCK PLANTS

Figure 4

The plants in the left three rows of paper pots came from seed of a normal parent; these were all normals. The right three rows of plants came from seed of a Slender parent; these were partly Slenders and partly normals. The "Slender" mutant is due to the fact that there is an extra unpaired chromosome in addition to the seven pairs found in the cells of normal stock plants.

CHROMOSOME-MUTANT TYPES IN STOCKS

(*Matthiola Incana* R. Br.). I. Characters Due to Extra Chromosomes*

HOWARD B. FROST†
University of California

THE evidence for the chromosome theory of heredity has been much strengthened by cases where abnormal numbers of chromosomes are present. Thus "haplo-IV" Drosophila[5] breeds as if it carried only one set of the genes that are supposed to be carried by the fourth pair of chromosomes, and it actually has only one chromosome belonging to the normal fourth pair. The "Poinsettia" type of Datura[4] breeds as if it had three chromosomes in place of a normal pair, and its somatic cells contain one extra chromosome.

In Datura, the 12 normal pairs of chromosomes indicate the possibility of 12 simple-trisomic types, each having one extra chromosome derived from a different normal pair. Such a mutant form, characterized by the presence of a normal or unmodified extra chromosome, is called a *primary* trisomic; 11 such forms have been satisfactorily identified in Datura. Other Datura trisomics are called *secondary*, because in these cases the extra chromosome seems to be modified or abnormal. Studies of some of these secondaries indicate that their extra chromosomes are normal in size but have been modified by abnormal (reversed) crossing-over.[2]‡

The Trisomic Types

Matthiola§ has produced extra-chromosome forms somewhat resembling those of Datura. One variant form, Early, discovered only once and now lost, may have been due to gene mutation; it was fewer-noded and earlier than the parent variety, but seemed to lack entirely the weakness, partial sterility, and various peculiarities of leaf shape which characterize the other mutant types.[7] Aside from Early, at least eight mutant types have been repeatedly produced by a glabrous, white-flowered, "double-throwing" variety secured from a seedsman under the name "Snowflake." With good germination, the progeny of normal parents have commonly included about four or five per cent of mutants.

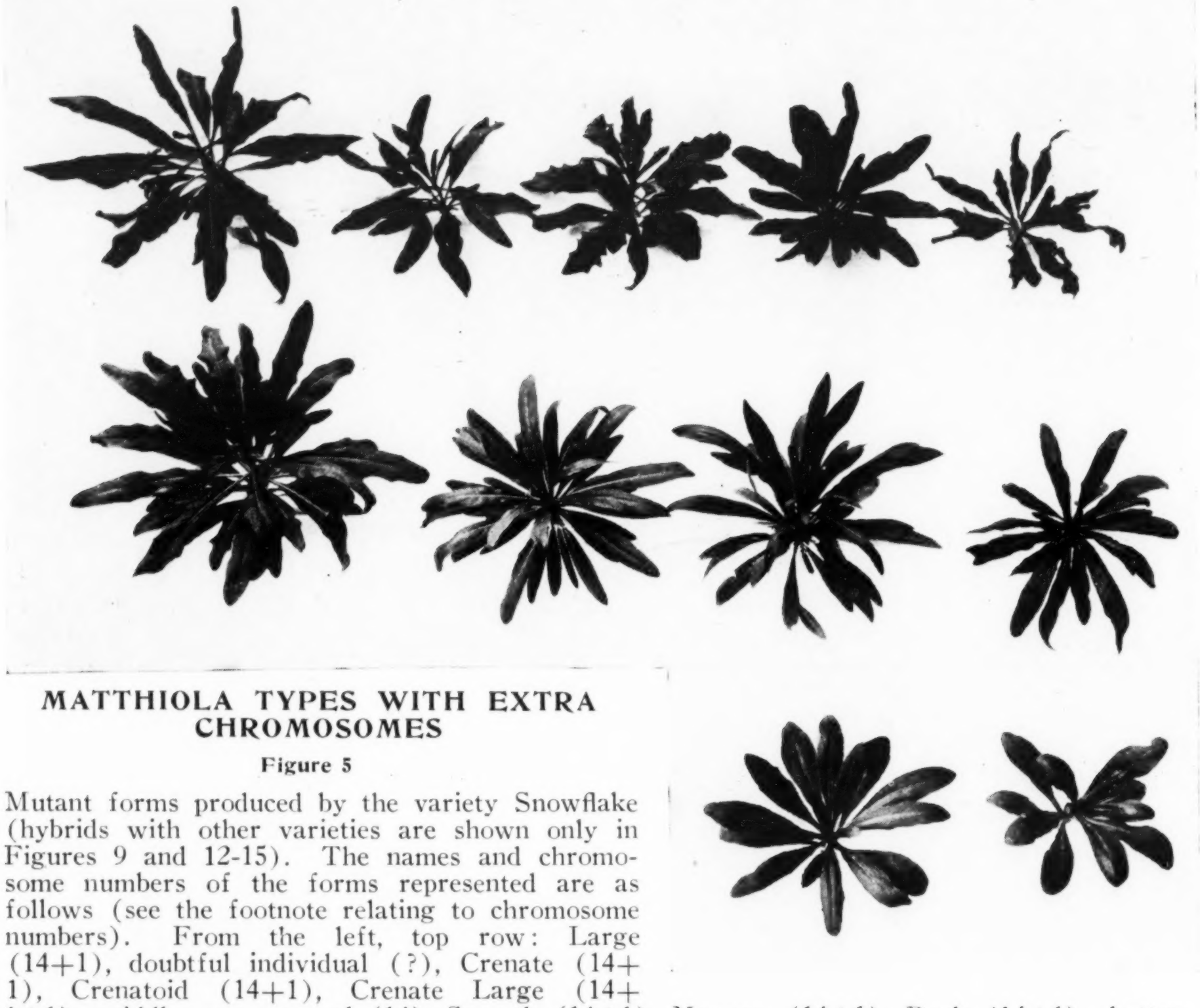
These mutant types, listed approximately in the order of their frequency of occurrence as mutants from normal Snowflake, have been named as follows:[7] Smooth-leaved, Crenate-leaved, Narrow-leaved, Dark-leaved (formerly Narrow-dark-leaved), Small-smooth-leaved, Slender, Large-leaved, Convex-leaved. The few Small-smooth mutants produced by Snowflake have given no seed; this type resembles but may be distinct from a type named *Small*, which has recently been studied among the progeny of a fairly fertile hybrid mutant.[10] Young plants of six of these types are shown in Figure 5, and Figure 12 includes the other two (Slender and Small). Of these eight forms, seven (including the hybrid Small) have been determined to have in the pollen mother cells an

*Paper No. 165, University of California, Graduate School of Tropical Agriculture and Citrus Experiment Station, Riverside, California.

†Nearly all the cytological evidence mentioned in this paper has been secured by Mrs. Margaret Mann Lesley, of the Division of Genetics, College of Agriculture, University of California. A brief summary of the earlier cytological results has been published,[8] and the evidence is to be more fully presented in papers now in press or in preparation.[9,10,11]

‡For discussion of various considerations relating to chromosomal mutation, the reader is especially referred to the papers on Datura which are here cited.

§ See Literature Citations 7, 8, 9, 10, 11.



MATTHIOLA TYPES WITH EXTRA CHROMOSOMES

Figure 5

Mutant forms produced by the variety Snowflake (hybrids with other varieties are shown only in Figures 9 and 12-15). The names and chromosome numbers of the forms represented are as follows (see the footnote relating to chromosome numbers). From the left, top row: Large (14+1), doubtful individual (?), Crenate (14+1), Crenatoid (14+1), Crenate Large (14+1+1); middle row: normal (14), Smooth (14+1), Narrow (14+1), Dark (14+1); bottom row (younger plants): normal (14), Convex (15). Note the smaller size of the plants with more than 14 chromosomes, and their differences in shape and size of leaves.

extra unpaired chromosome in addition to the seven pairs possessed by normal plants. One plant of the eighth type, Convex, in poor condition, had 15 unpaired chromosomes.* In Large and Slender, somatic cells have been examined; they have 15 chromosomes, instead of the 14 chromosomes of the normal type.[1,8,9]

If reproduction were entirely regular in these trisomic forms, half of their eggs should carry an extra chromosome, making eight in all, and the other half should have the normal complement of seven chromosomes. The same should be true of the sperms. Crossing with normal plants (seven chromosomes in gametes) should then give progeny consisting of about 50 per cent of trisomics like the trisomic parent, with 15 chromosomes, and 50 per cent of normals with 14 chromosomes. In the same way, selfing of trisomics should give about 25 per cent of simple *tetrasomics* with 16 chromosomes, 50 per cent of trisomics and 25 per cent of normals.

Genetic tests of these forms have

*Chromosome counts have been obtained by Dr. Lesley from plants of the variety Snowflake for all these simple-trisomic types except Narrow and Small-smooth, and from the F_2 hybrids mentioned below for all these types (including Small) except Convex. The counts for the tetrasomic and combination types were made from either Snowflake or hybrid plants, occasionally both. In the legends accompanying the figures, the somatic chromosome numbers characteristic of the forms shown are usually given; "14+1+1," for example, indicates two *unlike* extra chromosomes (presumably non-homologous, except with Crenate Slender), and "14+2" indicates two *homologous* extra chromosomes. Chromosome counts have been made for some but not all of the individual plants in the figures.

been much hampered by their low vigor and fertility. The Snowflake trisomics Crenate, Large and Slender have been crossed reciprocally with Snowflake normals, and Smooth has been used as seed parent. Large, Slender and Smooth have also each been crossed with normal plants of from one to four pure single races, all of which are decidedly unlike Snowflake.†

Progeny from selfing of seven of the mutant forms mentioned (all but Convex) have been grown; with Narrow, Dark and Small, however, little or no seed has been secured except from mutant individuals among the F_1 hybrids from crosses of other trisomics with pure single races. In all these cases the mutant form has reproduced itself in part of the progeny (Figure 4), but the proportion of normals has usually been greater than the expectation stated above. The highest proportion of mutant-type progeny given by any Snowflake trisomic, about 50 per cent, has been produced by selfing of the relatively vigorous Large type.[7] Tetrasomic progeny, with two homologous extra chromosomes, have usually been absent or scarce.

The deficiency of trisomics is doubtless due to disturbance of the reduction division and of later development by the extra chromosome. There is evidence indicating (1) that the extra chromosome sometimes fails to be included in the gametes, (2) that pollen carrying an extra chromosome accomplishes fertilization less often than does normal pollen,[8] and (3) that zygotes with extra chromosomes are less viable in the embryo stage.[7] When tetrasomic plants, with two similar extra chromosomes, appear, they are usually small and weak; it is not strange, therefore, that few tetrasomics survive beyond the embryo stage.

In Matthiola, then, as in Datura,[3] the developmental tendencies of the normal complement of chromosomes must be delicately balanced. An extra dose of one kind of chromosome reduces vigor, and two doses are usually fatal. The difference in vigor between trisomics and normals has commonly been decidedly greater in the field than with potted plants grown in a coldframe or greenhouse. This is doubtless due to the severer weather conditions (favoring excessive transpiration) and the root competition in the former case. The illustrations in this paper, mostly showing young potted plants, do not adequately indicate the difference in vigor as shown by average final developments *in the field* at Riverside. Except as noted in the legends, the figures show potted plants, grown in a greenhouse and photographed in fall or winter.

The hybrids have shown a decided increase in vigor over the parent varieties. Doubtless largely on this account, it has been possible to secure an abundance of seed from several trisomic forms which had previously proved largely or entirely sterile at Riverside. This fact emphasizes earlier indications that the usual low fertility of the trisomics is largely due to the low general vigor of the plants.

One, Two and Three Extra Chromosomes

The trisomics Large and Slender are in general more vigorous and fertile than the rest. They are very unlike, and they characteristically differ from the normal type in opposite directions in the following respects: (1) Large (Figures 7 and 8) has large, thick leaves, often rolled and twisted, while Slender has narrow, thin leaves, tending to lie flat; (2) Large is stout throughout, while the name "Slender" is strikingly appropriate to that type; (3) Large (Figure 9) is late in flowering, while Slender is early. Large grows more slowly than the normal form, and

†Two of these pure single races were grown from seed kindly furnished by Miss Edith R. Saunders.

produces fewer leaves; it tends to approach normal in plant size, although it does not set seed nearly as well under unfavorable climatic conditions. Slender plants are typically smaller than normals, and their capsules are usually small and poorly filled.

Extreme or tetrasomic Slender (Figures 6 and 7) has remarkably splender stems and leaves, and is early in blooming. It often occurs, in small numbers, among the progeny of selfed Slender parents; it has two extra chromosomes, which are sometimes paired in the first division in the pollen mother cells.[8] Tetrasomic Large also occurs, at least among the hybrids; it is small and very late, and its leaves are few and twisted (Figure 13).

The combination (double trisomic) form, Large Slender (Figures 8 and 9), with two extra chromosomes, is often produced when Large and Slender are intercrossed. This form combines very definitely certain characters of Large and Slender. The plants resemble Slender in usual size in the field, but in time of flowering (Figure 9) they are intermediate. The leaves are narrow but very long, and are fewer and thicker than with Slender. Large Slender shows more sterility than either Large or Slender.

When Large Slender plants are selfed, the progeny include normal, Large, Slender, and Large Slender, and also occasional plants with more than two extra chromosomes. Some plants (Figure 7, at right below) differ from tetrasomic Slender in about the same way as Large Slender differs from trisomic Slender. Dr. Lesley finds that these plants have three extra chromosomes, making a total of 17. Doubtless two of these extra chromosomes are like that of trisomic Slender, and one is like that of Large. Several plants have had characters suggesting the presence of two extra Large chromosomes, with one extra Slender one, but chromosome counts have not yet been secured; such plants are small and late, with thick, narrow leaves.

Crenate (Figures 5, 10 and 12) is distinguished from normal by short, broad leaves, with a greatly increased tendency to serration or dentation. In the field at Riverside the Snowflake Crenate plants have usually been small, and have rarely produced any seed. They are decidedly smaller, weaker and less fertile than Slender plants. Flower buds are often produced abundantly, but they are usually abortive or at least inflated and sterile. In the appearance of the small leaves near the racemes, Crenate somewhat resembles Slender, but the leaves are in general short and broad, not long and narrow. The extra chromosome of Crenate has been found by Dr. Lesley to be usually longer than that of Slender.

A cross between Slender and Crenate gave one little plant whose leaves combined the narrowness of Slender and the dentation of Crenate. This Crenate Slender plant had two extra chromosomes, one short like that of Slender and one long like that of Crenate.

In two Crenate Large plants (Figures 5 and 11), the leaves combined the dentation of Crenate with the thickness and twisting of Large. The plant in Figure 11 was found to have two extra chromosomes,[8] one short like that of Large and one long like that of Crenate.

Figures 5 and 10 illustrate a trisomic form occurring in one line from Crenate ancestry, which is similar to Crenate but apparently distinct. It has been tentatively designated "Crenatoid." It has shown considerably less leaf dentation than Crenate, and is apparently somewhat more vigorous and fertile. Unlike Crenate, it seems to give ordinary ratios for double flowers among its progeny. If Crenate is a primary trisomic form, Slender and Crenatoid appear to be corresponding secondaries. It should be

THE SLENDER TYPE IN THE FIELD

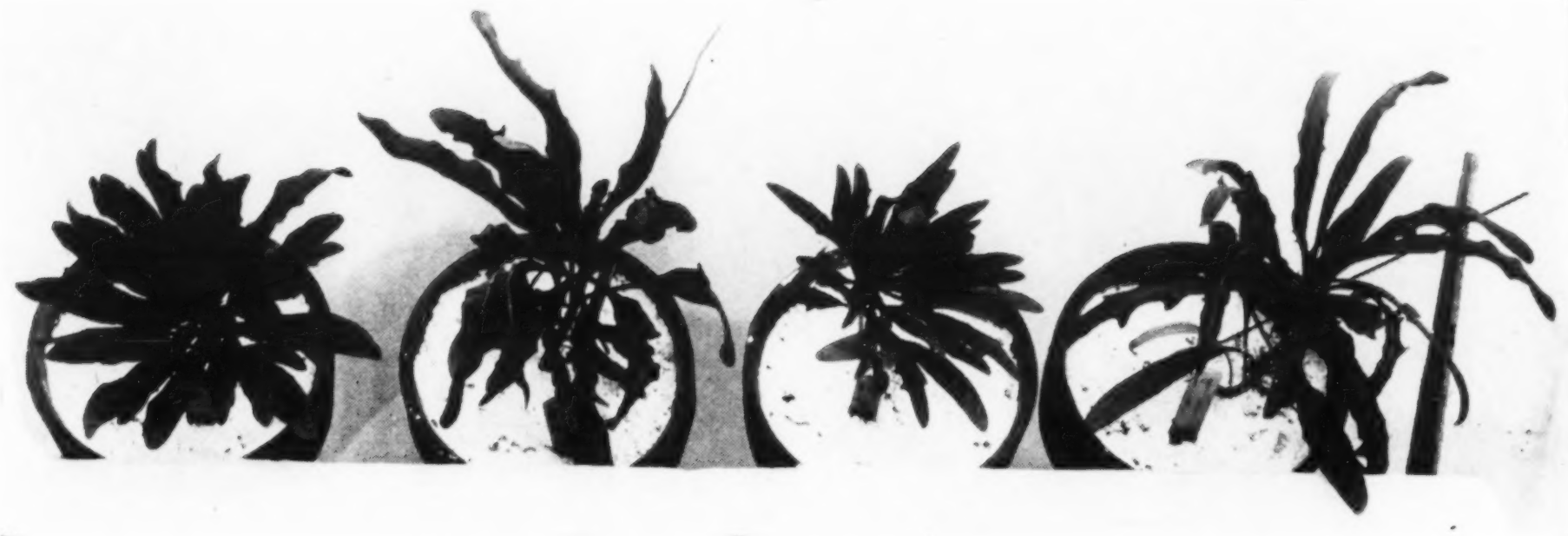
Figure 6

From left to right: normal (14), extreme Slender (14+2), Slender 14+1). The "Slender" chromosome produces early blooming.

ONE, TWO AND THREE EXTRA CHROMOSOMES

Figure 7

Types and their chromosomes, from the left above: normal (14), Slender (14+1), extreme Slender (14+2); below: Large (14+1), Large Slender (14+1+1), Large extreme Slender (14+1+2). The "Slender" chromosome makes the leaves narrower; the "Large" chromosome makes the leaves fewer.



SIMPLE AND DOUBLE TRISOMICS

Figure 8

Plants grown in a shaded coldframe in summer. The types and their chromosome numbers are as follows, from left to right: normal (14), Large (14+1), Slender (14+1), Large Slender (14+1+1).

SIMPLE AND DOUBLE TRISOMICS (HYBRIDS, F_1)

Figure 9

From left to right: normal (14), Large (14+1), Slender (14+1), Large Slender (14+1+1). The differences in earliness that are shown are typical.

noted, however, that Slender has a small extra chromosome, which presumably originated through fragmentation of a normal chromosome, while the Datura secondaries seem as a rule to have extra chromosomes of normal size. No cytological difference between Crenate and Crenatoid has been discovered.

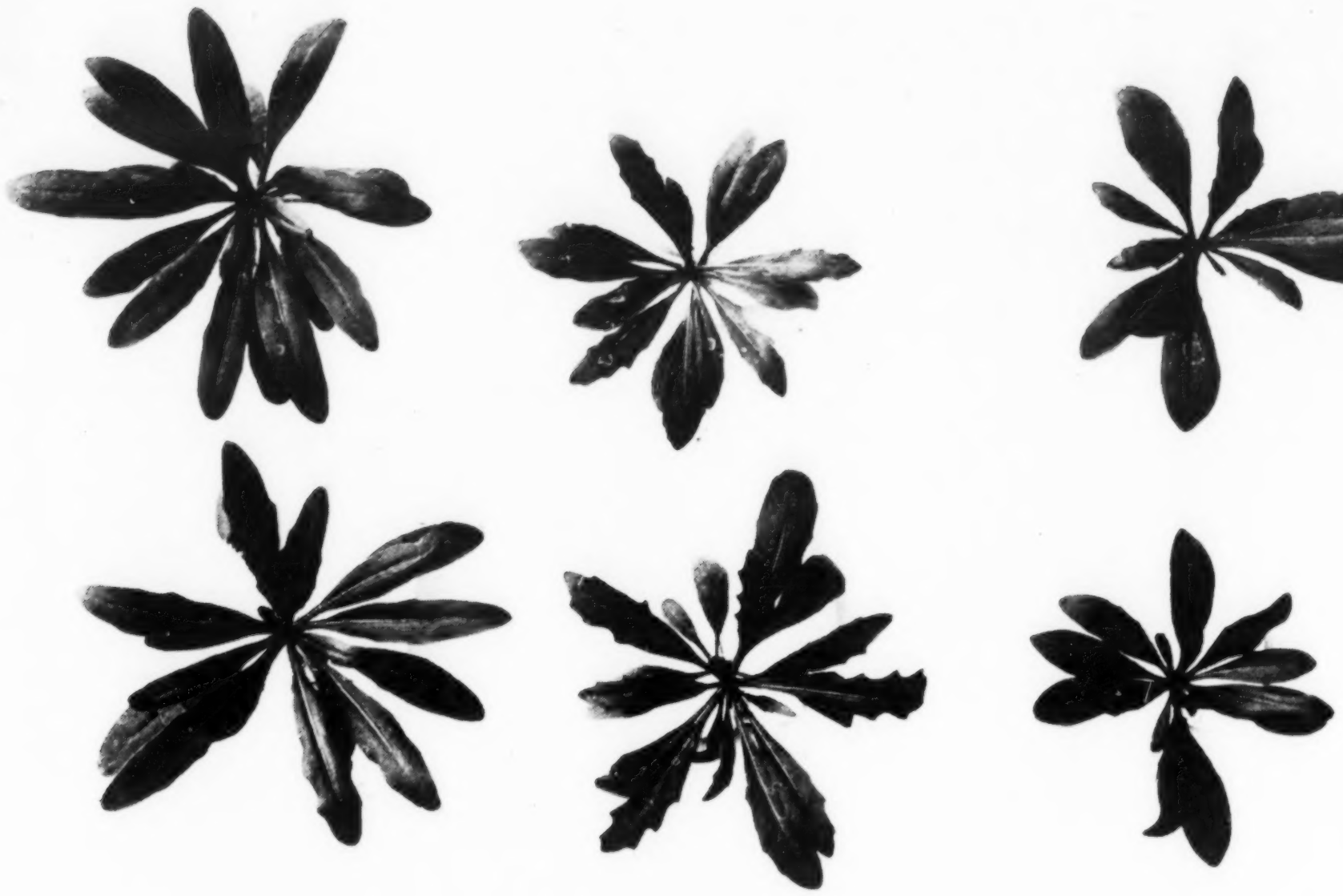
At the first division in the pollen mother cells, as Dr. Lesley has shown,[8] a trisomic Matthiola plant usually has a *separate* extra chromosome, not conjugated with any of the seven pairs of chromosomes. Although this odd chromosome is usually shorter in Slender than in Crenate, the inheritance of doubleness of flowers indicates that it is derived from the same normal pair.[8] It is therefore evident that in at least one of these forms (Slender) the extra chromosome is a fragment of a normal chromosome, and that this fragment usually remains unconjugated while the corresponding normal chromosomes pair.

The breeding evidence seems to require such cytological behavior. If the three chromosomes in the trisomic group conjugated at random in both Crenate and Slender, we should expect that at least one of these forms, when selfed or crossed with normal, would give a considerable percentage of another trisomic form. Thus, if Crenate has a complete, normal extra chromosome and Slender a fragment, random segregation in the trisome group of Slender should give many gametes with a complete extra chromosome, and these, meeting normal gametes, should produce Crenate zygotes. Or, if the extra chromosome is a fragment in both these forms, they should both produce, with random segregation, many trisomic progeny of a third type, having a complete extra chromosome. Neither of these possibilities, however, is realized. Although Crenate and Slender possibly arise from each other more often than from normal parents, the percentages of such "mutants" are very small. The progeny of Crenate are almost entirely Crenate and normal, and the progeny of Slender are almost entirely Slender and normal. Their behavior in this respect resembles that of primary Datura trisomics and their secondaries.[2]

The Dark trisomic (Figures 5 and 12) is small, compact and late to bloom; its leaves are small, dark green, and often much rolled back at the edges. Its extra chromosome also tends to cause a considerable increase of corolla size, both in the Snowflake trisomic and in hybrids. In this respect Dark resembles the "enlarged" trisomic of Nicotiana.[6] Since this effect occurs within the variety Snowflake, as well as in hybrids, it appears to be a matter of chromosome balance, not involving heterozygosis. Evidently the extra chromosome of Dark carries some gene or genes tending to increase flower size, and three doses of these genes in each cell have more effect on the flower than the normal two doses.

The Large type has a small extra chromosome, very similar to that of Slender, which is probably a fragment. There is reason to suspect that Large (Figures 5, 8, 9 and 12) is a secondary trisomic, Dark (Figures 5 and 12) being the corresponding primary. In form, number and position of leaves in the young seedlings, in the characteristically dark leaf color, and in the tendency to rolling and twisting of the leaves, these types are similar. The plants of Large typically reach a greater size, with much larger leaves, and are more fertile. Large differs from Dark in having corollas of normal size, but a papillose or rugose condition of the petals, which is usually present in Large and is very often an excellent diagnostic character, is often somewhat developed in Dark (Figure 15). This condition, together with a tendency in these forms to crumpling of the apical part of the petal, doubtless depends on the same growth tendencies as do the rolling and twisting of the leaves which characterize these types. Dark

Slender



CRENATE AND CRENATOID

Figure 10

In each row, from left to right: normal (14), Crenate (14+1), Crenatoid (14+1). Crenatoid leaves are short and broad like those of Crenate, but are less toothed or serrate.

LARGE SLENDER AND CRENATE LARGE IN THE FIELD

Figure 11

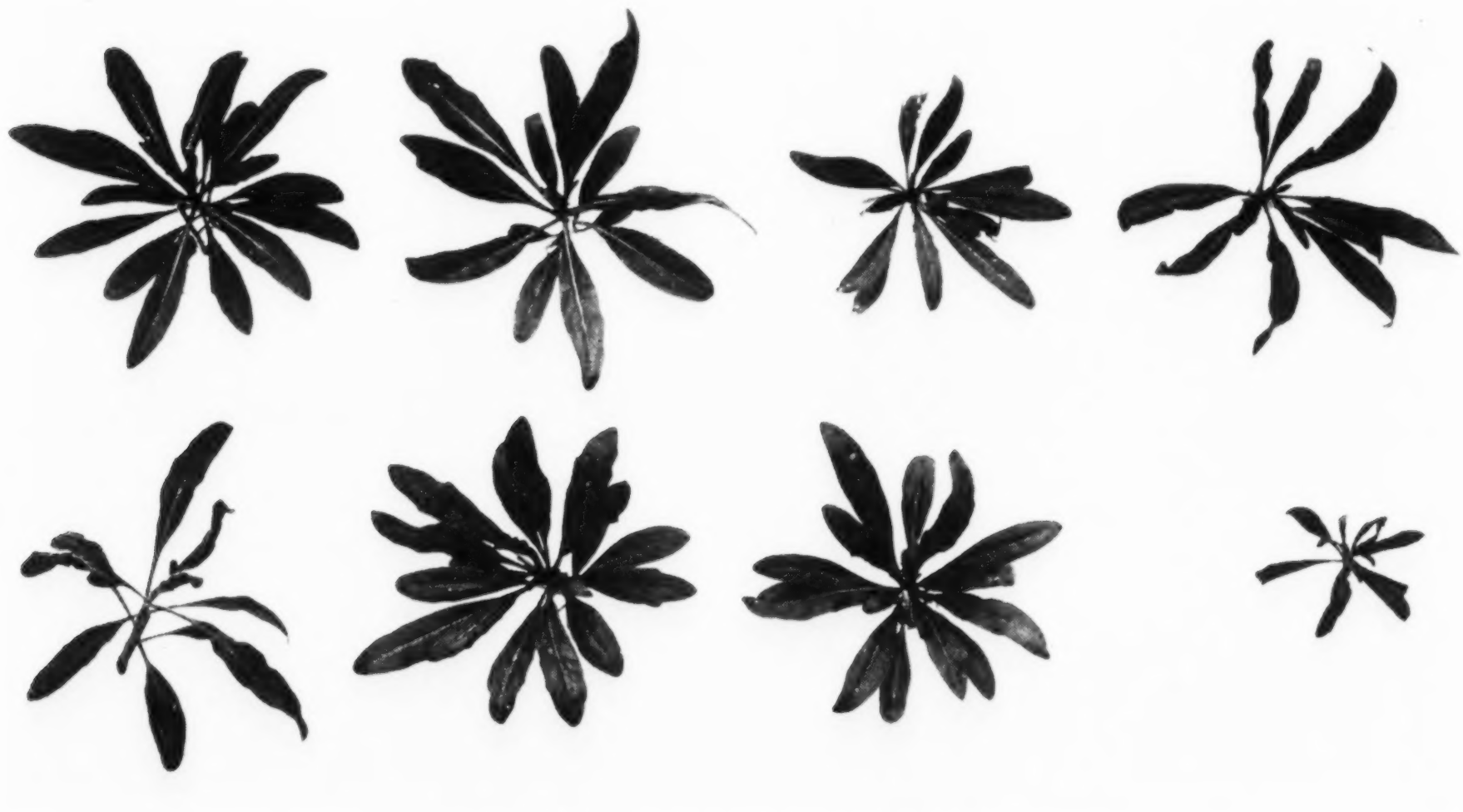
At left: Large Slender (14+1+1); at right: Crenate Large (14+1+1). The striking difference between these double trisomics evidently depends on the difference between the long, bent extra chromosome of Crenate and the short, often almost globose extra chromosome of Slender.

SIMPLE TRISOMICS (HYBRIDS, F_2)

Figure 12

From the left above: normal, Crenate, Slender, Smooth; below: Dark, Large, Narrow, Small. All but the Narrow plant are descended from the same grandparental pure single race. Compare with the Snowflake trisomics in Figure 5.

Note added January 2, 1928: Small-smooth now seems distinct from the hybrid Small; therefore, although the extra chromosome of the latter is a small fragment, it is still possible that the former is a primary trisomic.



LARGE AND SMOOTH HYBRIDS IN F_2

Figure 13

Plants and chromosome numbers, from the left above: normal (14), Large 14+1), Smooth (14+1), Large Smooth (14+1+1); below: extreme Large (14+2), normal (14), Smooth (14+1), extreme Smooth (14+2). The first five plants and the last three are derived, respectively, from crosses with two different pure single races.

NORMAL AND LARGE SMOOTH HYBRIDS (F_1), IN THE FIELD

Figure 14

Left: normal (14); right: Large Smooth (14+1+1). The Large Smooth plant was small; its leaves were fewer, longer and thicker than those of Smooth.

commonly has a conspicuously "veiny" corolla, the veins being exceptionally prominent beneath and depressed above, and the corolla appears somewhat more veiny with Large than with normals (Figure 15).

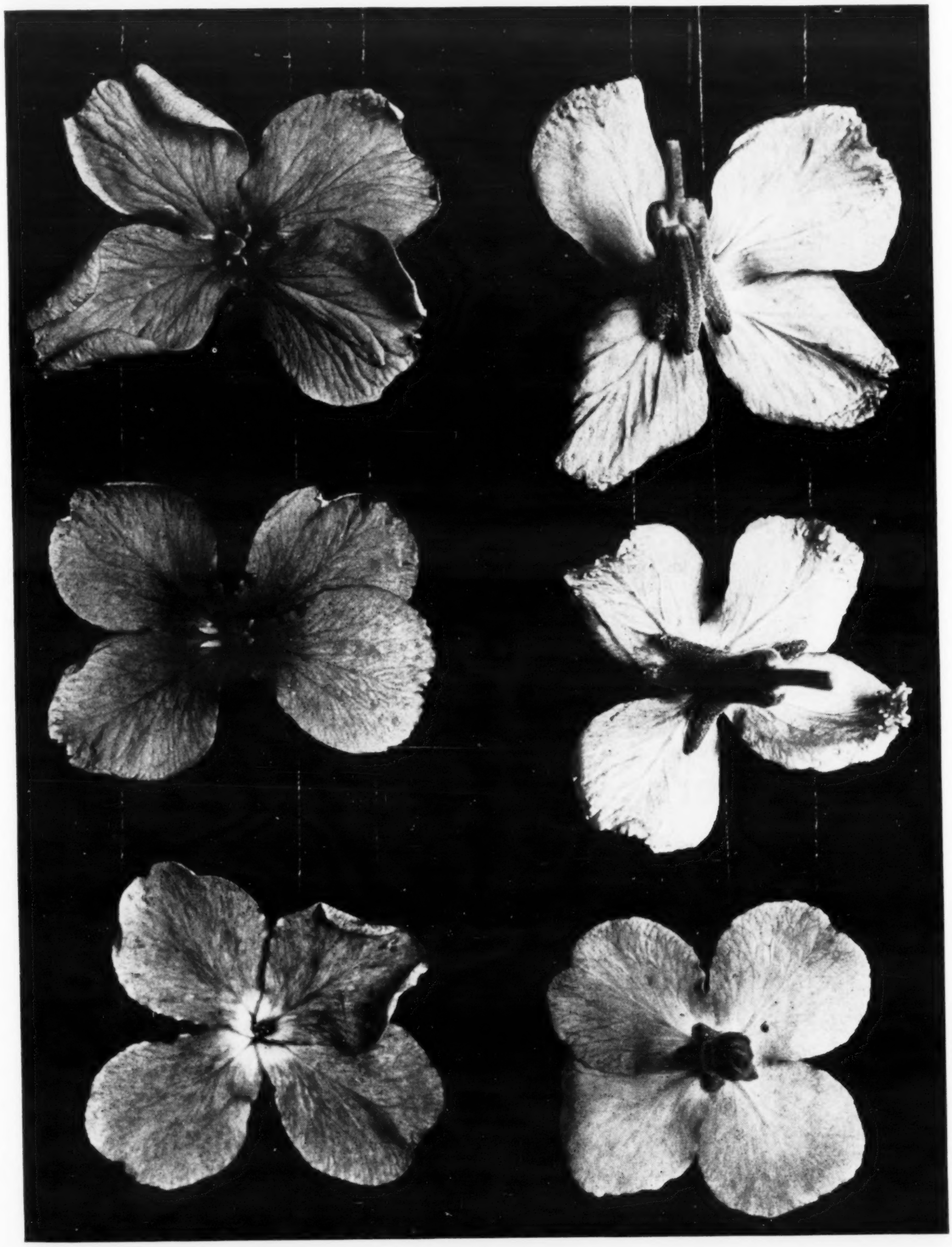
Smooth (Figures 5, 12 and 13), unlike Large and Dark, has numerous, thin, straight, smooth, divergent leaves, tending to light color. The corolla, in marked contrast to that of Dark, is commonly reduced in size.

Smooth occasionally produces an extreme form, which has been found to be tetrasomic (Figure 13). One Large Smooth plant (Figure 14) came from a cross between Large and normal; its progeny included normal, Large, Smooth, and Large Smooth (Figure 13); Large Smooth is a double-trisomic form, with two non-homologous extra chromosomes.

The hybrid Small type (Figure 12) has numerous, small, short, flat, divergent leaves, with the tips rounded about as with normal plants, and conspicuously small flowers and capsules. Seed from the one mutant hybrid gives a considerable percentage of Small progeny. Resemblances in several somatic characters suggest that the very small extra chromosome of Small[10] is a fragment of the larger one that is characteristic of Smooth.

Narrow (Figures 5 and 12) has leaves that contrast strongly with those of Small; they are fairly long, rather narrow, often very convex when young, ascending and pointed. This form has usually shown low fertility even as a hybrid. The extra chromosome of Narrow and that of Small must carry some very unlike genes for leaf characters, as do the extra chromosomes of Large and Slender. In width and dentation of leaves, Narrow contrasts sharply with Crenate.

Among the progeny of Slender parents, an occasional Narrow Slender mutant has been found. One such plant was determined by Dr. Lesley



FLOWERS OF LARGE AND DARK HYBRIDS

Figure 15

Two flowers from each of three plants of one F_2 family. Upper pair: Dark (large, veiny petals); center pair: Large (papillose petals); lower pair: Normal. (Because of a mild mosaic disease, the left-hand flower of the normal plant was slightly mottled, and the other probably somewhat abnormally smooth.)

to have two unpaired extra chromosomes, which respectively resembled the large one of Narrow and the small one of Slender.

Convex (Figure 5) is a small, slow-growing form, appearing occasionally as a mutant, from which no seed has been obtained. Its leaves are short, small, and strongly convex upward, and have short, broad petioles.

In various form characters, therefore, different trisomics differ in opposite directions from the normal type. The trisomics sort out and hold up to view, as it were, some of the opposing developmental tendencies represented by particular chromosomes or portions of chromosomes, whose balanced cooperation in the normal set of 14 chromosomes produces a "normal" plant. We cannot assume, however, that all these differences relate to complete normal chromosomes, for in at least three cases (Large, Slender and Small) the extra chromosome evidently is a fragment of a normal chromosome.[8,9,10]

Since the four trisomic forms (Smooth, Crenate, Narrow and Dark) which have arisen most frequently from normal Snowflake all have relatively large extra chromosomes, these *may* be primary trisomics like those of Datura, each having a complete, normal extra chromosome.

The crosses involve several gene differences for sap color. Indications have been obtained that the extra chromosome of Smooth tends to reduce the intensity of seed (embryo) color in the capsules of the F_1 hybrids mentioned above. Whether this effect is due to genes that are heterozygous in the F_1 hybrids, is not yet known.

The extra chromosome of Narrow intensifies F_1 flower color in two crosses, and in F_2 many, but not all, of the Narrow plants show the deeper color. In these crosses the F_1 hybrids were heterozygous for the gene *B*, which changes red sap color to purple. The F_2 ratios for these colors suggest that the extra chromosome of the F_1 Narrows carried *B*. It is therefore probable that the intensification was due either to *B* or to some gene or genes linked with it.

In F_2 from at least one cross, part of the Dark trisomics have lighter flower color than their normal sibs. The P_1 races therefore probably differ with respect to a pair of genes whose locus is in the extra chromosome of Dark.

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CONGENITAL EPITHELIAL DEFECTS OF CALVES

Epitheliogenesis Imperfecta Neonatorum Bovis—A Recessive Brought to Light by Inbreeding

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IN 1912 a calf with epithelial defects was brought to our attention. It was out of a pure-bred Holstein cow owned by the University of Wisconsin. During the following ten years several case reports and specimens of similarly defective calves were received. A composite of these case reports and the postmortem records was made in order to determine the nature of this undescribed affection of newborn calves. This compilation showed the following lesions to be characteristic: defective formation of the skin below the knees and hocks; one or more undeveloped claws; deformed ears, due to rolling of the margins and growing together of the surfaces brought into contact, indicating that these lesions antedated birth by some weeks; defects in the integument of the muzzle and in the mucous membrane of the nostrils, tongue, hard palate, and cheeks. (See Figure 16).

To secure more detailed information about the affection, a questionnaire was mailed to all veterinarians in Wisconsin and to veterinarians at the various agricultural experiment stations in the United States. The answers to this questionnaire showed that the affection had been recognized by a number of Wisconsin veterinarians, but by none outside the state. It also brought out the interesting fact that all the defective calves observed were either pure-bred or grade Holsteins. Moreover, the calves were carried full term and were of normal size at birth. Some appeared strong when born, others were weak and unable to stand and all soon became debilitated and died even when given appropriate medical treatment and good care. Death was attributed to a septicemia that developed from infection which gained entrance to the body through the raw surfaces of the lesions.

Several of our correspondents thought the epithelial defects were due to inbreeding. Some thought they were the result of a mineral deficiency and felt that they had hit upon the cause and remedy when no further cases occurred after alfalfa or clover hay was provided as a part of the ration. Others suggested that an infectious agent was responsible. Still others thought the defects were due to retarded functioning of a gland of internal secretion during fetal life, possibly the thyroid; but when potassium iodid failed to prevent the recurrence of defectives in the herd, this gland could no longer be incriminated. Moreover, no thyroid enlargement was noted in any of the calves or in their dams. Infection with *Bacterium abortum* (Bang) was eliminated as a possible cause by applying the agglutination test to the dams of many of the defective calves. (See Table II).

To date we have authentic records on exactly fifty similarly defective calves, thirteen of which were dropped in one herd. These represent fifteen different grade or pure-bred Holstein herds, all of which are located in Wisconsin. Undoubtedly many other calves with the same defects have been born in the state, but they have

*Grateful acknowledgment is made for the hedpful suggestions given by Dr. L. J. Cole and Dr. B. L. Warwick in conducting this study.

not been brought to our attention.

Origin of the Defect

That the same defects occur in certain calves born in Holland, the original home of the Holsteins, is attested by Dr. Plank of the Veterinary High School in Utrecht, who has traced ancestors of some of our defective calves to the Dutch herds in which similarly defective calves have been dropped. This foreign investigator reported that the description of the calves that we sent him was identical with the cases he has seen. He is convinced that the lesions can be attributed to the results of inbreeding; but he feels that the condition is not of common occurrence, as inbreeding is practised very often yet defective calves are seldom the result. In fact, it appears from his preliminary study to be confined to cattle belonging to only one breeding society.

It seems unnecessary to incorporate in this paper all the extended pedigrees and other data that have been gathered in our fifteen-year study of these defective calves. However, there are certain facts that should be recorded in order to give an idea of the methods used in conducting the study and the basis for our conclusions.

Table II records the known historical facts about each of the thirteen defective calves in Herd IV. Of particular interest is the fact that all the calves were sired by the bull Sir Johanna Beauty Segis 248564, who was also the grandsire of six of them.

Figure 17 brings out graphically the relationship of these calves and shows the source of the factors responsible for Sir Johanna's undesirable, yet completely hidden, trait. It also shows his immediate ancestors and some of his descendants. This bull traces four times to Sarcastic Lad-Johanna blood lines. Notice is drawn to the fact that nearly every cow which dropped a defective calf gave birth to one or more normal calves.

Figure 18 is the extended pedigree of one of the defective calves shown in Table II and in Figure 17. This calf's pedigree is typical of many others by Sir Johanna. It shows that the dam is the sister of a defective calf and that she traces to a Sarcastic Lad-Johanna union. In other words, this defective calf traces on both sides to Sarcastic Lad-Johanna blood lines.

Table I brings out the frequency with which the bull Sarcastic Lad 23971 and cows of the Johanna family appear in the pedigrees of the defective calves. Investigation showed that in practically every pedigree this bull had been mated to a Johanna cow. On the other hand not one of these direct matings, with a possible exception, resulted in a defective calf. However, when certain descendants of the calves represented here were mated with descendants by this bull but out of other cows, the result was at least one defective calf and, in some cases, two.

The greatest havoc was wrought in Herd IV (see Figure 17), in which inbreeding was practised to a far greater extent than is customary in grade herds. This intensified the homozy-

TABLE I—Names and Register Numbers of Pure-Bred Holstein Cows with which Sarcastic Lad 23971 Was Mated. The First Generation of Calves Were All Normal. Later when the Descendants of This Bull Out of Other Cows Were Mated with Descendants of the Cows Represented Here, or when the Progeny of These Cows Were Mated, Some of the Calves Had the Epithelial Defects

Johanna Rue 21223 III, V, X, XI, XIV	Johanna Rue 2d 33788 I
Johanna Arggie 36477 VII	Johanna De Kol 36478 IV, X
Johanna Clothilde 40384 II	Johanna De Kol 2d 42168 IV
Johanna Friend 45164 VI, VIII, IX, XI, XII, XIV	Johanna Aaggie 2d 45165 VIII
Johanna Rue 4th 45166 VIII	

NOTE:—The Roman numerals refer to the identification numbers of the herds to which the defective calves belong. With the exception of one herd, in which the bull could not be positively identified, all of the 15 herds studied are represented in this chart.

A TYPICAL CASE OF THE EPITHELIAL DEFECTS

Figure 16

This case exhibits typical lesions. Notice the denuded, raw-appearing areas below both the knees and the hocks. The hoofs on the fore feet are normal, but the hind feet have no hoofs. The left ear is deformed, due to adhesions having occurred before birth between the surfaces in contact. The epithelial covering of the muzzle and nostrils is defective in some places and abnormally thin in others. The calf was carried full term and weighs about 100 pounds.

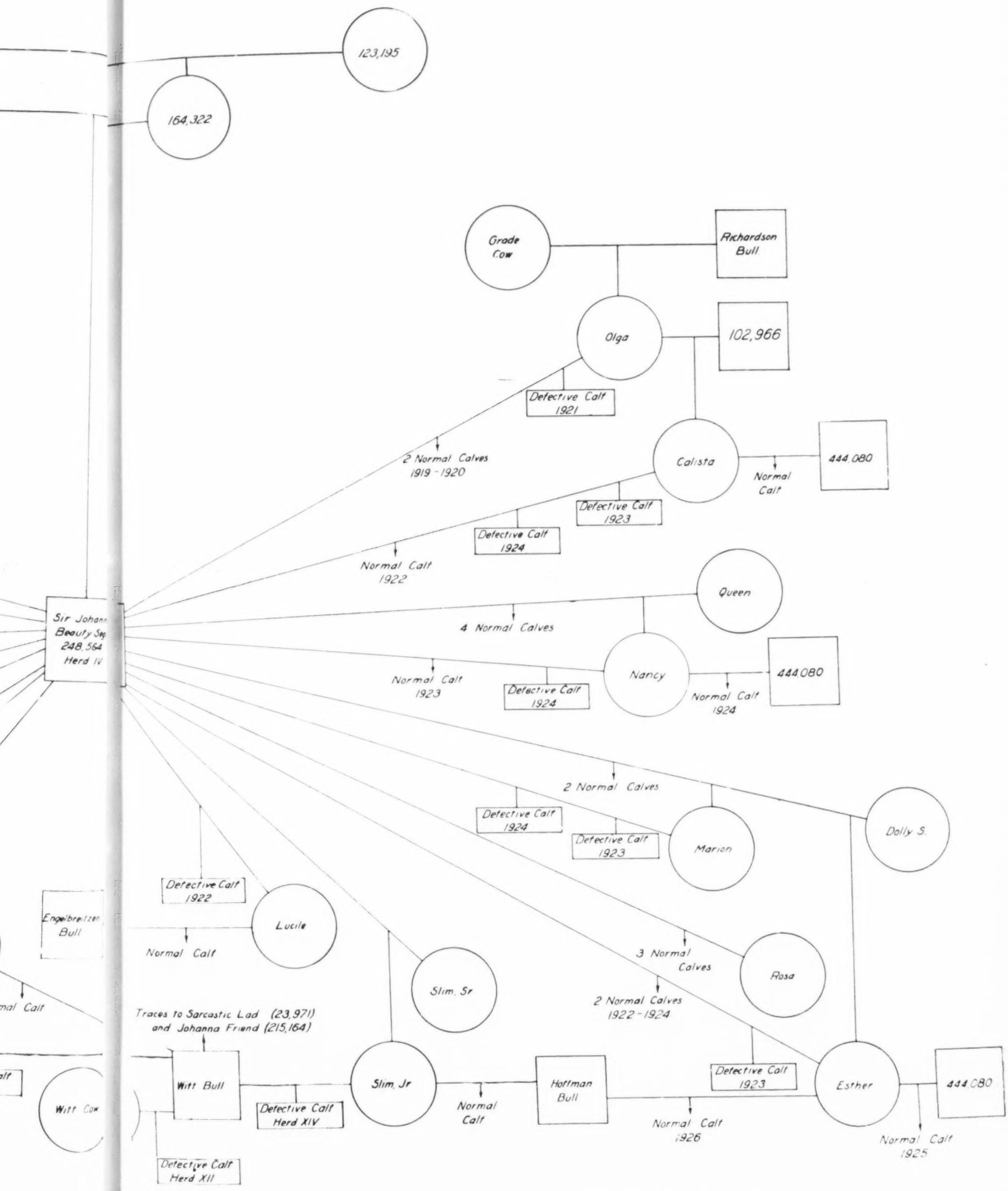
gosity already present in the herd bull, Sir Johanna, by stabilizing the germ plasm. It resulted in increasing the homozygosity of both dominant and recessive characteristics and provided an opportunity for the expression of the deleterious recessive factor for epithelial defects that was latent in the germ plasm. Every one of these calves was doomed to die shortly after birth. Even if all known preventive measures for both prenatal and postnatal care had been taken with their dams, these calves would have died.

Attention is particularly called in Figure 17 and Table II to the grade cows Delene, Frankie, Olga, and Lucile, all of which were of unknown origin yet gave birth to defective calves when bred to Sir Johanna. It is reasonable to assume that each must have carried either Sarcastic Lad or Johanna blood, or blood from both, thus constituting the means whereby the recessive factor for the defects was inherited.

The other cows in Herd IV that dropped defective calves were all closely related to the herd sire, Sir Johanna, so it is easy to account for some of their calves being defective. In this connection it is instructive to study the breeding history of the cows Jane, Cherries, Gussie, Esther, and Calista, all of which produced defective calves when mated with their sire or grandsire, Sir Johanna, but normal calves when mated with non-related bulls.

Especial notice is drawn in Figure 17 to the full sisters Edna and Irma, as well as to the full sisters Marion and Esther. Edna had a normal calf by the Witt bull, an animal that had

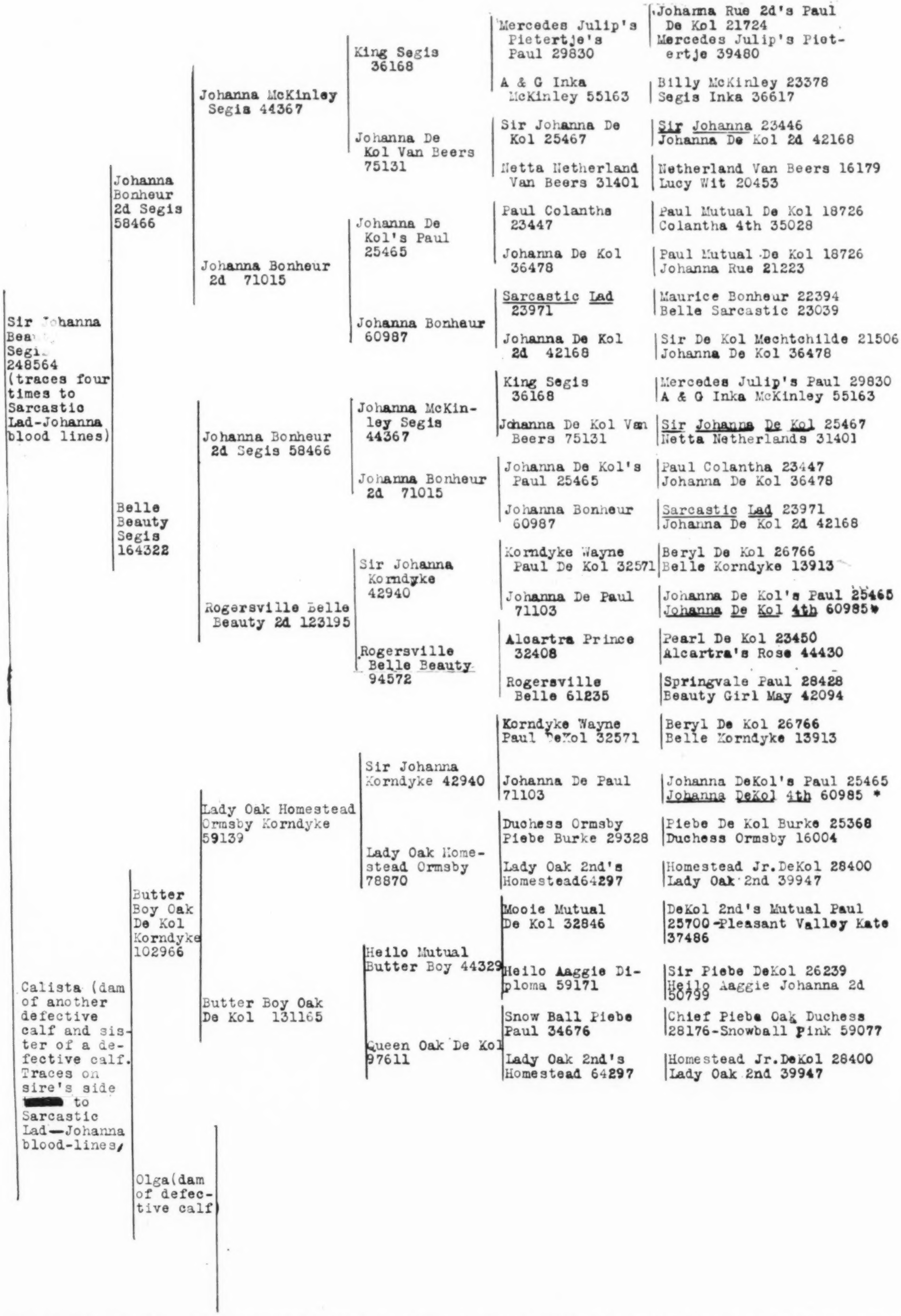
Traces twice to Sarcastic Lad (23,971) and Johanna Rue (21,223)
61,312
Defective Calf Herd III
Defective Calf Herd III
59,466
110,393
Traces to Sarcastic Lad (23,971) and Johanna De Kol (36,478)
199,296
86,952
200,604
303,677
Defective Calf Herd X
Monroe Bull
Normal Calf
Cleo
444,080
Normal Calf 1924
Jane
4 Normal Calves
Defective Calf 1922
Normal Calf 1923
Unidentified Bull
Normal Calf
Delene
Defective Calf 1919
Sir Johanna Beauty Segis 248,564 Herd IV
Savage Bull
Frankie
Defective Calf 1919
2 Normal Calves 1922-1924
Hoffman Bull
2 Normal Calves 1924-1925
Cherries
Defective Calf 1923
Normal Calf
Engelbreitzen Bull
Alberta
Gussie
Defective Calf 1924
Edna
Normal Calf
Edith
Irma
Defective Calf Herd XIV
Witt Cow
Normal Calf 1925
Normal Calf 1926
444,080
Hoffman Bull



RELATIONSHIP OF DEFECTIVE CALVES

Figure 17

Diagram showing pedigrees of 19 of the 50 defective calves studied. Two of these calves were in Herd III, thirteen in Herd IV, one in Herd X, one in Herd XII, and two in Herd XIV. Sir Johanna Beauty Segis sired 13 defective calves and 133 that were normal. In at least four lines he is descended from Sarcastic Lad-Johanna ancestry.


Johanna Bonheur 2d Segis 58466
Sir Johanna Beauty Segis 248564 (traces four times to Sarcastic Lad-Johanna blood lines)
Belle Beauty Segis 164322
Calista (dam of another defective calf and sister of a defective calf. Traces on sire's side [redacted] to Sarcastic Lad—Johanna blood-lines)
Olga(dam of defective calf)
Johanna McKinley Segis 44367
Johanna Bonheur 2d 71015
Johanna Bonheur 2d Segis 58466
Rogersville Belle Beauty 2d 123195
Lady Oak Homestead Ormsby Korndyke 59139
Butter Boy Oak De Kol 131165
King Segis 36168
Johanna De Kol Van Beers 75131
Johanna De Kol's Paul 25465
Johanna Bonheur 60987
Johanna McKinley Segis 44367
Johanna Bonheur 2d 71015
Sir Johanna Korndyke 42940
Rogersville Belle Beauty 94572
Sir Johanna Korndyke 42940
Lady Oak Homestead Ormsby 78870
Heilo Mutual Butter Boy 44329
Queen Oak De Kol 97611
Mercedes Julip's Pietertje's Paul 29830
A & G Inka McKinley 55163
Sir Johanna De Kol 25467
Netta Netherland Van Beers 31401
Paul Colantha 23447
Johanna De Kol 36478
Sarcastic Lad 23971
Johanna De Kol 2d 42168
King Segis 36168
Johanna De Kol Van Beers 75131
Johanna De Kol's Paul 25465
Johanna Bonheur 60987
Korndyke Wayne Paul De Kol 32571
Johanna De Paul 71103
Alcartra Prince 32408
Rogersville Belle 61235
Korndyke Wayne Paul DeKol 32571
Johanna De Paul 71103
Duchess Ormsby Piebe Burke 29328
Lady Oak 2nd's Homestead64297
Mooie Mutual De Kol 32846
Heilo Aaggie Diploma 59171
Snow Ball Piebe Paul 34676
Lady Oak 2nd's Homestead 64297
Johanna Rue 2d's Paul De Kol 21724
Mercedes Julip's Pietertje 39480
Billy McKinley 23378
Segis Inka 36617
Sir Johanna 23446
Johanna De Kol 2d 42168
Netherland Van Beers 16179
Lucy Wit 20453
Paul Mutual De Kol 18726
Colantha 4th 35028
Paul Mutual De Kol 18726
Johanna Rue 21223
Maurice Bonheur 22394
Belle Sarcastic 23039
Sir De Kol Mechtchilde 21506
Johanna De Kol 36478
Mercedes Julip's Paul 29830
A & G Inka McKinley 55163
Sir Johanna De Kol 25467
Netta Netherlands 31401
Paul Colantha 23447
Johanna De Kol 36478
Sarcastic Lad 23971
Johanna De Kol 2d 42168
Beryl De Kol 26766
Belle Korndyke 13913
Johanna De Kol's Paul 25465
Johanna De Kol 4th 60985 *
Pearl De Kol 23450
Alcartra's Rose 44430
Springvale Paul 28428
Beauty Girl May 42094
Beryl De Kol 26766
Belle Korndyke 13913
Johanna DeKol's Paul 25465
Johanna DeKol 4th 60985 *
Piebe De Kol Burke 25368
Duchess Ormsby 16004
Homestead Jr.DeKol 28400
Lady Oak 2nd 39947
DeKol 2nd's Mutual Paul 25700-Pleasant Valley Kate 37486
Sir Piebe DeKol 26239
Heilo Aaggie Johanna 2d 50799
Chief Piebe Oak Duchess 28176-Snowball Pink 59077
Homestead Jr.DeKol 28400
Lady Oak 2nd 39947

PEDIGREE OF DEFECTIVE CALF NO. 4 IN HERD IV (BORN MARCH 29, 1924)

Figure 18

previously sired a defective calf. This tends to show that she did not inherit the factor responsible for the epithelial calf defects, but does not absolutely exclude the possibility as another calf out of her and by this sire might have been defective, since the ratio of defectives to normals is about 1:3. Irma, on the other hand, must have carried the recessive factor, because the first and only calf she produced by the Witt bull was defective.

Now notice the progeny of Dolly S. by Sir Johanna and their records. This cow produced four normal calves by Sir Johanna. Two of them were vealed; the other two were raised and identified as Marion and Esther, respectively. When Marion was bred back to her sire, she produced two defectives. The cow Rosa, which produced three normal calves, is a half sister of the two cows just mentioned, her sire being the Stauffacher bull, from an unrelated herd. Esther, however, produced one defective and two normal calves when mated with her sire and one normal calf by the bull 444,080. The latter bull, by the way, traces to Sarcastic Lad-Johanna on both his sire's and dam's sides, but he never sired a defective calf, although he was given every opportunity to do so by mating not only with Esther, but also with Nancy, Calista, and Gussie, which had produced abnormal offspring, as well as with several other cows in Herd IV that undoubtedly carried the factor for the defects.

The above statement also holds true for the Hoffman bull, which was procured especially for experimental breeding use in Herd IV because he was considered a good prospect for carrying the deleterious factor, as he came from Herd VIII and traced, at least on one side and possibly both, to Sarcastic Lad-Johanna ancestors. This animal's performance illustrates how difficult it is to select from the history an individual that carries a recessive factor and clearly demonstrates not only the difficulties and cost of conducting experimental work of this kind, but also the fact that not more than one out of four animals that may possibly carry this recessive factor actually does.

Our selection of the Witt bull from Herd XII to head Herd XIV proved to be a most fortunate choice, as Herd XIV was assembled primarily for testing out certain cows to detect their genetic make-up for the factor in question. After he had served only six cows, all of which were of unknown genetic makeup, he was tested with tuberculin and reacted, so had to be slaughtered, much to our regret, as we had not an opportunity to mate him with ten other cows that had dropped defective calves by another sire. Fortunately, however, two of his progeny out of two of the former cows proved to be defective and two normal, while two fetuses were aborted. This record stamps him as a "black sheep" and unfit for service in a Holstein herd carrying the blood of the foundation stock under discussion. This would also be true in most grade herds of unknown parentage in Wisconsin where the Sarcastic Lad and Johanna families are widely distributed.

Economic Importance of the Defect

The monetary loss incurred by the owner of Herd IV, in which thirteen defective calves were born within a period of a few years, was so great as to discourage him and nearly to force him out of business. Fortunately, after we had studied the breeding history of the herd, we were able to tell him why so many of his cows had dropped defective calves. The remedy was, of course, obvious; that is, to dispose of the bull Sir Johanna, who had been responsible for the trouble.

It should be stated that Sir Johanna sired 133 calves, only 13 of which were defective, leaving 120 perfectly normal calves to his credit. Further, a full brother of Sir Johanna was used as a sire for a number of years in an-

other herd, but no defective calves resulted. This was either because this bull did not carry the recessive factor, or because he was not mated to cows which carried it. A half brother of these bulls was kept as the herd sire by a relative of the owner of Herd IV on an adjoining farm for a number of years, but he never sired a defective calf, presumably for the same reasons just stated.

We believe the data here presented justify the assertion that a recessive factor was responsible for the defects in these calves; furthermore, that this factor was introduced into the United States with cattle brought from Holland in the early days of Holstein-Friesian importation; moreover, that the factor remains submerged until certain animals, both of which carry it, are mated. In this event, it outcrops as a double recessive in the form of the characteristic lesions described and photographed. Although it is impossible to trace the pedigrees of the grade dams, it is reasonably certain that they were related to the bull Sarcastic Lad.

Summary

Summarizing, it may be stated that this study of congenital epithelial defects in calves warrants the statement that they are distinctly heritable for the following reasons:

(1) Because they occur only in related families of Holstein cattle.

(2) Because the lesions are practically identical in every case, being symmetrical as well bilateral.

(3) Because there is no evidence to show that they are either the result of infection (*Bacterium abortum*), or of ductless gland disturbances (goiter).

(4) Because the defectives occur in about a 1:3 ratio with normals.

(5) Because the calves all die shortly after birth, so the factor is lethal, or at least amounts to the same thing, as the animals are never able to survive the infection which is acquired through the denuded areas soon after birth.

Conclusions

The epithelial defects described have

TABLE II—Records of Calves in Herd IV with Congenital Epithelial Defects

No. of Calf	Name of Cow	Sire of Cow	Dam of Cow	Sire of Defective Calf	Date of Defective Calf's Birth	Length of Gestation Period	Other Calves by Sir Johanna	Agg. test for Abortion 2/29/24
1	Delene	Unknown	Unknown	Sir Johanna Beauty Segis	1919	About Normal	None	
2	Frankie	Unknown	Unknown	Sir Johanna Beauty Segis	1919	About Normal	None	
3	Olga	Richardson bull	Unknown	Sir Johanna Beauty Segis	5/3/21	283 days	Normal calf '19 also '20	
4	Lucile	Engelbreitzen bull	Unknown	Sir Johanna Beauty Segis	6/13/22	283 days	None	
5	Jane	Sir Johanna Beauty Segis	Cleo	Sir Johanna Beauty Segis	7/5/22	281 days	Normal calf '23	Negative
6.	Cherries	Savage bull	Frankie (see #2)	Sir Johanna Beauty Segis	3/9/23	283 days	Normal calf '22 also '24	Negative
7	Esther	Sir Johanna Beauty Segis	Dolly S.	Sir Johanna Beauty Segis	4/4/23	279 days	Normal calf '22 also '24	Negative
8	Calista	Claggett bull	Olga (see #3)	Sir Johanna Beauty Segis	5/24/23	281 days	Normal calf '22(see #11)	Negative
9	Marion	Sir Johanna Beauty Segis	Dolly S.	Sir Johanna Beauty Segis	5/31/23	281 days	See #13	Negative
10	Nancy	Sir Johanna Beauty Segis	Queen	Sir Johanna Beauty Segis	1/9/24	280 days	Normal calf '23	Negative
11	Calista	Claggett bull	Olga (see #3)	Sir Johanna Beauty Segis	3/29/24	280 days	See #8	See above
12	Gussie	Sir Johanna Beauty Segis	Alberta	Sir Johanna Beauty Segis	4/8/24	No record	None	
13	Marion	Sir Johanna Beauty Segis	Dolly S.	Sir Johanna Beauty Segis	5/13/24	No record	See #9	See above

been proved to be definitely inherited by the production of defective calves through selected matings and by studying the pedigrees of 50 similarly defective calves belonging to 15 different herds. These defective calves are not a new creation, having been observed by us from time to time during the past 15 years. They have occurred in several generations.

This study shows that the defects are reappearances of characteristics that have been carried under the surface as recessive genes in the germ plasm. Undoubtedly the modification occurred first as a mutational change in a single gene before it appeared in two genes and became a double recessive capable of outcropping.

The fact that most of the defective calves described have appeared in a relatively restricted geographic area indicates that cattle bearing the same gene have been mated. Furthermore, it would seem that the failure of such defectives to occur more generally was due to the chance of suitable combinations being so small.

There is little probability that this defect would ever become widespread or permanently established itself, as the breeder would eventually select against it. However, until breeders are better informed about genetics many of them will continue to mate normal appearing cattle, carrying the gene for the defect, without realizing the potential possibilities for disaster, as did the owner of Herd IV.

As one of the aims of science is to keep accidents from happening, we believe the work herein reported was worth doing in that it points the way by which cattle breeders, through controlling the mating of their animals, can absolutely prevent the recurrence of defective calves which would be doomed to die shortly after birth.

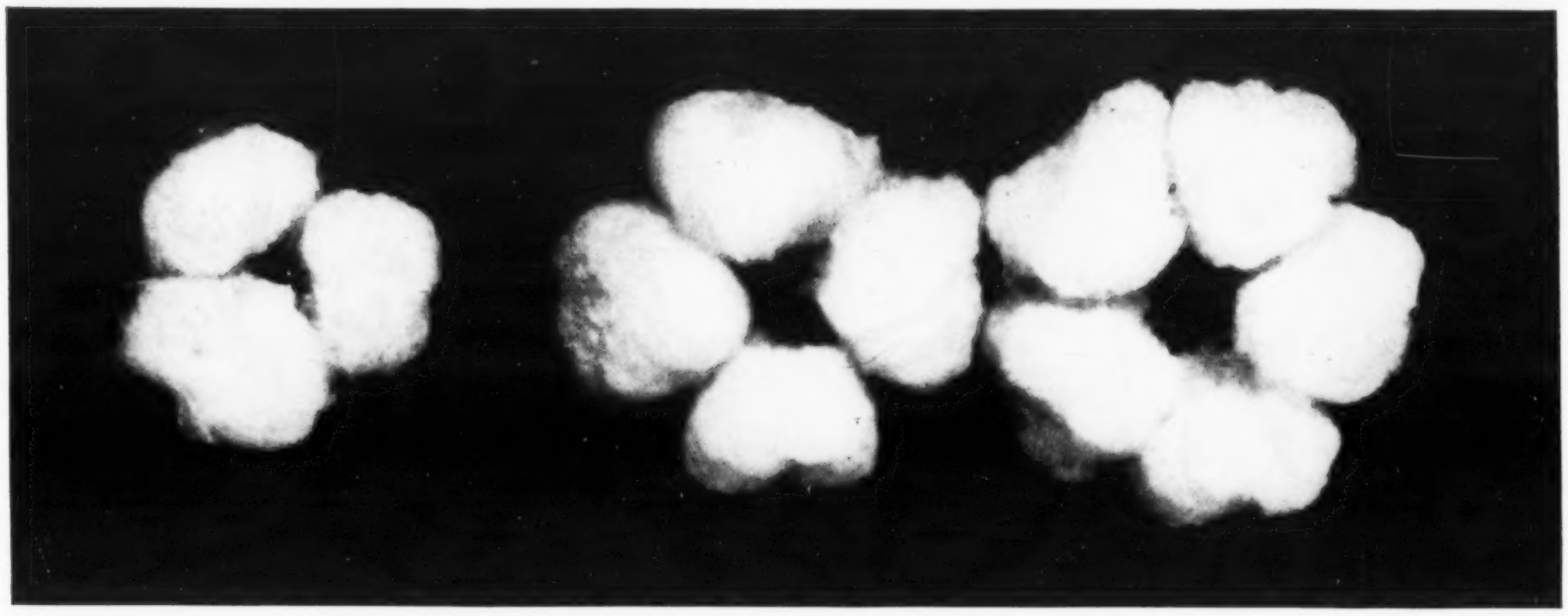
Three Generations of Imbecility Enough for the Supreme Court

IN the case of *Buck vs. Bell*, in which the constitutionality of the Virginia Sterilization Law was upheld by the United States Supreme Court, Mr. Justice Holmes disposed of the questions at issue in a brief and lucid opinion:

"The attack is not upon the procedure but upon the substantive law. It seems to be contended that in no circumstances could such an order be justified upon the existing grounds. The judgment finds the facts that have been recited and that Carrie Buck 'is the probable potential parent of socially inadequate offspring, likewise afflicted, that she may be sexually sterilized without detriment to her general health and that her welfare and that of Society will be promoted by her sterilization,' and thereupon makes the order. In view of the general declaration of the legislature and the specific findings of the Court obviously we cannot say as a matter of law that the grounds do not exist, and if they exist they justify the result. We have seen more than once that the public welfare may call upon the best citizens for their lives. It would be strange if it could not call upon those who already sap the strength of the state for these lesser sacrifices, often not felt to be such by those concerned, in order to prevent our being swamped with incompetence. It is better for all the world, if instead of waiting to execute degenerate offspring for crime, or to let them starve for their imbecility, society can prevent those who are manifestly unfit from continuing their kind. The principle that sustains compulsory vaccination is broad enough to cover cutting the fallopian tubes. *Jacobson v. Massachusetts*, 197 U. S. 11. Three generations of imbeciles are enough."

A NEW VARIETY OF COTTON FROM CHINA

J. B. GRIFFING, *University of Nanking*



ASIATIC COTTON WITH FIVE-LOCKED BOLLS

Figure 19

At left: boll of common Chinese cotton having the usual three locks. At right: bolls of Million Dollar variety, showing bolls having four and five locks. Under favorable conditions over sixty per cent of the bolls have the extra locks.

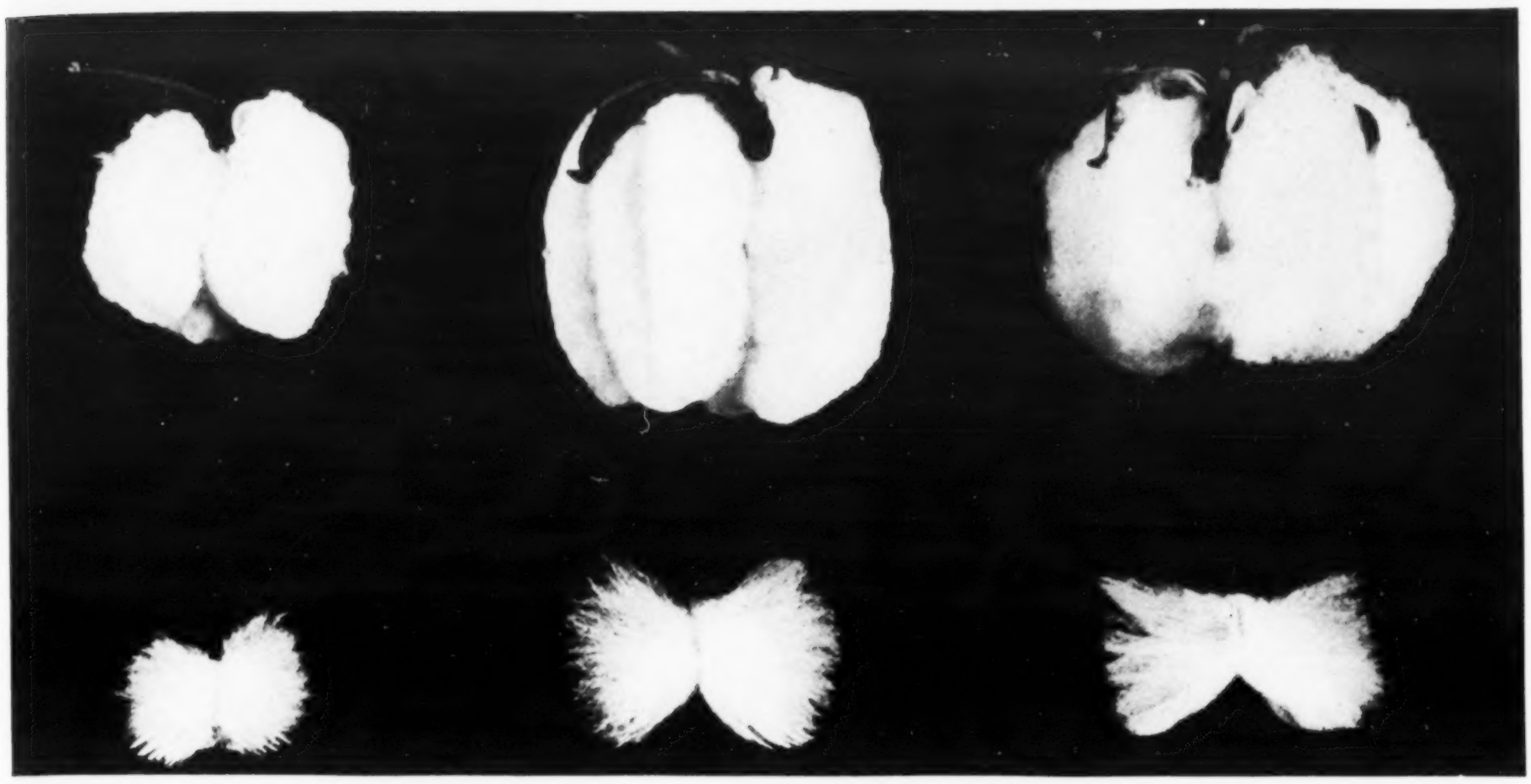
A VARIETY of cotton recently developed from the native stock in China, bids fair to modify the popular belief that none of the Chinese cottons can compare favorably with American Upland. Most Chinese cottons have very short, coarse lint and a small three-locked boll. The new variety, known as the "Million Dollar," while distinctly Asiatic, bears almost as marked a contrast to common Chinese cotton as do the good American varieties.

The Million Dollar is the progeny of a single plant. This plant was discovered by the writer in the autumn of 1919 at Woosung, near Shanghai. The discovery was the result of a search for superior individuals as a preliminary step in the cotton improvement program inaugurated by the College of Agriculture and Forestry of the University of Nanking.

Most fields of Chinese cotton are mixtures of diverse types, and hence present an unusual opportunity for selection. Varieties, as such, are not recognized save as cotton types are named by some very evident physical character. For example, the Chinese call a certain cotton "Chickenfoot" because its deeply lobed leaf resembles the foot of a chicken. Yet in a field with this chicken-foot leaf, the writer observed six distinctly different flower types and a corresponding diversity was observed in lint and seed characters.

In the selection work over 40,000 individuals were studied, but none approached the Million Dollar in its quality and length of lint. From the sample of seed-cotton taken from the original plant in 1919, seven plants were grown in 1920. These were remarkably uniform and similar in all characters to the original parent. Their flowers were all selfed and the progeny was henceforth grown in isolated fields.

In type the plant is slightly larger and coarser than the average Chinese cottons, although the fine, tall, slender stalk and deeply lobed leaf are typically Asiatic. The color of the plant is dark green, with a touch of red in the veining of leaves and the stem. The flower is yellow, with deep purple spots



CHINESE AND AMERICAN COTTON

Figure 20

Left to right: bolls of "chickenfoot," a native Chinese cotton; of the New Million dollar variety, and of the Trice variety, an American cotton acclimatized in China. The combed out fibre below shows the relative length of staple. (About half natural size.)

at the base of the petals. For a Chinese cotton, the bolls are unusually large. Moreover, in a favorable soil about 60 per cent are four-locked, and a few have five locks. In no other Chinese cotton has the writer ever seen a boll of more than four locks. With most types comparatively few bolls have more than the normal three. The seeds are very large for a Chinese cotton, running from eight to ten grams per hundred.

The outstanding character, however, is the lint. The length, when grown under favorable conditions, runs from an inch to one and one-sixteenth inches. Although there remains a little of the harshness that is characteristic of Asiatic cotton, yet the lint is remarkably soft and fine when compared with the common rough grades. The per cent ranges from 31 to 33, with a lint index (grams per 100 seeds) of 4.0 to 4.5.

By 1923 the increased plots gave a product sufficient for a spinning test in one of the British mills in Shanghai. There the lint was spun into various counts up to and including 42's, giving a yarn of unusual whiteness. Breaking tests were made of the standard 122-yard lea, in which the Million Dollar was compared with common Chinese cotton with the results shown below.

It is significant that the comparison could not be carried farther than the 17's because of the impracticability of spinning the common cotton into the finer counts. For anything approaching 42's the mills in China have always used American Upland or the best staples from India.

Fineness of yarn in counts	*Breaking strength in pounds of common Chinese cotton*	*Breaking Strength in pounds of Million Dollar cotton*
14's	68	96
17's	50	81
20's	—	59
32's	—	37
42's	—	23

MARTENS READILY TAMED

Figure 21

Martens raised in captivity become quite tame, as this picture shows. The European marten has been used for centuries as a pet because of its ability to keep houses free from rats. The demand for fur makes the breeding of martens in captivity an undertaking of considerable promise though only a beginning has been made in learning about the habits of the species.

BREEDING MARTENS IN CAPTIVITY

Progress Reported on Marten Breeding Experiments by United States Biological Survey

FRANK G. ASHBROOK and KARL B. HANSON
Division of Fur Resources; Bureau of Biological Survey,
U. S. Department of Agriculture

PRELIMINARY breeding experiments with martens were carried on in Pritchard, Idaho, by the Biological Survey, of the Department of Agriculture in 1913. The bureau's experimental farm there was abandoned and work was discontinued in the fall of 1915, however, and the martens were shipped to Washington, D. C., where for short time they were kept in the National Zoological Park. As a result of the preliminary work that was done at Pritchard, Idaho, and at Washington, D. C., it was decided to establish an experimental fur farm in the foothills of the Adirondack Mountains near Keeseville, N. Y. Operations were begun there about May, 1916, and six martens were shipped to the farm from Washington, D. C., in August, 1916. At the end of January, 1917, four more martens were obtained, making a total of ten breeding animals that were under observation.

The male and female martens were not allowed to run together except during January and February, which had been generally considered the breeding period. No young were produced during 1917, and six martens were lost between the breeding season of 1917 and that of 1918. Three died of disease, two from injuries, and one escaped. The breeding stock of martens for the year 1918 was thus reduced to four. No martens were born during 1918, 1919, and 1920.

During the fall of 1919 and the spring of 1920, considerable difficulty was experienced in keeping the male martens separated from the females, because the animals frequently burrowed under the carpet wire in the pens and mingled with one another. It was observed that no matter what time of the year they were together, the martens seemed to live harmoniously. These findings were not in agreement with those of A. H. Cocks,* an English naturalist who had conducted some experiments with pine martens in England. Mr. Cocks and may other naturalists reported that martens do not live happily together and will destroy one another at the slightest provocation if they are put together except during the mating season.

A general belief has prevailed that male and female martens can not be permitted to live together except during January and February. Since the contrary had been proved true on the Government experimental fur farm, it was decided to allow the males and females to live together there during all seasons of the year, except during the spring months, when martens usually whelp their young. They were reasonably tame, well fed, and in healthy condition, and therefore it was natural to believe that they would breed and produce young. Some consideration of this problem led to the belief that perhaps martens in captivity bred at another period than January or February. If this were true, then the explanation of failure to produce young might be found in the fact that the male and female martens were not together during the ordinary mating season.

On May 10, 1920, the males were turned in with the females. They lived together in a friendly manner and nothing of importance was observed until the latter part of July and early part of August, when they squealed

*COCKS, A. H. *Proc. Zool. Soc.* London, 1900, p. 836.

A FEMALE MARTEN

Figure 22

The martens are distributed throughout the North Temperate and sub-Arctic regions of the Northern Hemisphere. The Russian Sable and the American Marten are the most valuable species for their fur. The prolificness of the martens, and their shyness, have combined to prevent their extinction in the face of an intensive fur hunt that has continued for decades.

considerably and one of the females was seen to have received a severe injury to the ear. It was suspected that the martens were fighting, and separating the males from the females was considered. Early in the morning of August 13, 1920, the martens were making so much noise that the caretaker made a special visit to the pens to see what was the trouble. One pair was seen to mate, and observations later in the day revealed this as the cause of the peculiar squealing.

On August 26, 1920, all the male martens were put in pens separate from the females and kept separate until the latter part of November, and from then they were permitted to be with the females until April 4, 1921, when they were again separated.

The female marten which was bred during August, 1920, gained considerable weight from one to two months later and gave birth to a litter of three young on April 15, 1921. When the nest box was examined at this time one of the young appeared to be dead. No attempt was made to remove it, because the female was extremely nervous and excited, and for this reason the nest

THE MARTEN EXPERIMENT FARM

Figure 23

View of the Experimental Fur Farm near Keeseville, N. Y. The Marten pens are in the foreground. The observation-tower makes possible the study of the habits of the animals without disturbing them. In order to put fur-animal breeding and fur farming on a successful basis it is necessary to have a thorough understanding of the habits of the species that are utilized.

was left undisturbed for a few days. The next time the nest box was opened and examined two male martens were found, but there was no trace of the third litter mate, and the supposition was that it had been eaten by the mother. As the female marten was very nervous during the early life of her litter and was prone to snap the young in her mouth by the back of their necks and drag them roughly about the pen whenever she was disturbed, it was deemed inadvisable to disturb the family at such an early stage in life.

The young are born naked (without down or fur). A few days after birth the fur begins to grow and develops steadily in length and thickness. At four or five weeks of age young martens have a fairly heavy coat of dark maltese fur. One of the young martens started to open one eye on the 31st day, but this animal died the day after its eyes opened. The remaining member of the litter started to open one eye on the 35th day and both eyes were completely opened on the 37th day. The greatest development in this marten during the first three weeks was in the total length. Later on the growth was confined to a filling out of various portions of the body. At three weeks of age the young marten crawled about in the den. When 45 days old it would run into the chute whenever the cover of the den was lifted. It ventured forth from the den into the pen for the first time to eat feed out of the same dish with its mother on the 56th day. At eight and one-half weeks of age it would habitually stand sticking its head through the door of the den to observe what was going on outside.

The tentative conclusions based upon the findings thus far were:

(1) Male and female martens live agreeably together during most seasons of the year; (2) they should be together at all times except during

March, April, and May; (3) male martens will fight most ferociously whenever they come in contact; (4) martens normally breed in July and August —most generally in the early part of August; and (5) the normal period of gestation may be eight months and not two or three months as has been commonly believed.

After a careful study of the tentative conclusions it was decided to separate the sexes the next season (July and August, 1921), after satisfactory matings had been observed, and keep them separate until May of the following year.

The young marten raised on the experimental fur farm developed into an unusually fine specimen, growing to be slightly larger than its parents. Its fur was very dark brown and carried an exceptionally bright luster. The parents continued to thrive.

Conditions at the experimental farm at Keeseville, N. Y., were not satisfactory for keeping the martens under close observation. Since no matings were observed during the summer of 1921, the female was allowed to run with the male from July 13, 1921, to April 1, 1922. Although no matings were seen during this period, the marten that produced the litter in 1921 gave birth to three female young on April 16, 1922.

The male and female martens were separated on September 10, 1922, and kept separate until July, 1923, in order to determine if the gestation period be approximately eight months. In January, 1923, two of these four females died. One was the female that reared the two litters and the other was a young female born in the spring of 1922. Two females which were about four months old when they bred, failed to produce any young in the spring of 1923.

No evidences of pregnancy were detectable in the two females that died about five months after they were seen to breed. In connection with these experiments the question has arisen as to whether the fertilized ova in martens may lie in a somewhat dormant state for several months before noticeable embryonic development begins. Williams,* in discussing the duration of pregnancy in wild animals, states:

> Harms notes the peculiar fact that in the deer there is a period of 40 weeks between fertilization and the birth of the young, but this time does not represent the period of development of the fetus as we understand it in most animals. The ovum of the deer undergoes segmentation and then lies in the uterus for 4 months in an essentially dormant state. About December the distinctive embryonic development begins, and birth follows in May or June, about 5 months later. * * * * It is suggested that this delay in the development of the young is a provision by which it may be born at a favorable season of the year.* * * *

On April 6, 1927, a female marten, which was trapped in the wild during the latter part of December, 1926, gave birth to a litter of three young. This female only had access to a male, for a few hours every other day during the last three weeks of February. It is not believed that this animal was bred on any of these occasions, because it was observed that she would not tolerate the presence of the male. When he attempted to enter her pen she invariably drove him back to his own. It is believed that this female was bred in the wild some time prior to the time of her being trapped.

On August 19, 1920, a prominent breeder of silver foxes, who had been keeping martens for seven years without having young produced, visited the experimental fur farm at Keeseville, N. Y. The results he noted at the farm convinced him that male and female martens lived agreeably together during the summer months. On returning to his ranch he advised the keeper immediately to permit the practice, but as no matings were observed, it was concluded that the period of heat was over and the martens were put together too late. This rancher saw a pair of his martens mate in the latter part of July of the next year, and asserted that the male did not have access to the female

*Williams, Walter Long. Veterinary Obstetries, p. 169, 1917.

after the latter part of August, 1921. A litter was born during April, 1922.

Summary

All matings or signs of heat observed in martens at the Government experimental fur farm occurred between July 28 and September 3, particularly about the middle of August. On no occasions were signs of heat or mating observed during the winter months.

All the females that produced young had access to a male during the summer as well as the winter months.

In no instance did females ever produce young when they had access to a male during the winter months only.

Thus far it has not been possible definitely to determine if the summer matings are normal or whether the period of gestation is 2 to 3 months or approximately 8 months. Of the five females that were separated from the male after the summer mating period, only one was a proved mother. When this animal was separated, with a view of determining the length of the gestation period, she died, a few days before the middle of January, or approximately three months before the normal time of whelping.

The Human Constitution

RESEARCH concerning the human constitution received—in Germany at least—its strongest impulses from the work of Friedrich Kraus, the Berlin clinician. Especially his book "Die allgemeine und spezielle Pathologie der Person" influenced strongly the trend of clinical investigation. This book represented the first attempt to use the individual constitution as a general basis of understanding nosologic problems. Only then it became clear how much less we know about healthy individuals than about the sick, and it became evident that for the future development of the medical sciences, we required a detailed knowledge of the normal characters of the individuals of the different races. This is what Brugsch and Lewy call "the biology of the person," and their handbook* is intended to be a thorough foundation for the construction of the new science of the human constitution. In the foreword, the editors express their aim in the following words:

> We attempt to present this biology of the person as an initial contribution towards a future science of the human person which begins where anthropological research ceases. This, of course, means that our work differs from a "handbook" in the ordinary sense, the value of which consists in the critical digestion of the data of a certain field of inquiry, whereas the present handbook preferably demonstrates what is *not* known about the human constitution. This may seem paradoxical. However, the value of the work is to be found in the novelty of its attitude: constitutional research shall be freed from the chains of consideration from purely somatic-dispositional or genetical viewpoints and the field of investigation shall be extended to the psycho-physical person in its entity.

These principles probably account for the fact that the parts published so far represent a source of unusually valuable information. The different contributors have collected with great care the observed facts and the new angle of approach everywhere brings to light the gaps of our knowledge.

The first volume opens with an interesting sketch by Brugsch dealing with the historical development of constitutional research and its gradual molding towards a "science of the person" (Personallehre). E. Straus offers a logical discussion of the problem of individuality. He demonstrates in an unusually clear way the limits of the biological investigation of the organism as a whole. He repudiates likewise mechanism and vitalism as dogmata; vitalism because it is metaphysics and not

*Th. Brugsch und F. H. Lewy, *Die Biologie der Person.* A Handbook of the general and special studies of the constitution. Berlin-Wein, 1926.

biology; mechanism because *ex definitione* it cannot lead beyond an analysis of the parts and their action and thus never will help to understand the organism as a whole. The problem of individuality is a problem of logic and as such unaccessible to empirical analysis.

H. Salinger in the following chapter presents a summary of the most important statistical methods employed in biological and medical research. I. Kaupp discusses the meaning and importance of the conception of norms. He pays special attention to the correlations between the norms of size and the constitution and appraises the different factors of proportion as a scale for the constitution. W. Johannsen in a short contribution outlines the principles of general genetics and G. Just gives an account of human inheritance.

There follows a chapter by W. Lubosch with the title of "Individual-anatomie." The author's own definition for this new branch of anatomy is as follows: it is the description and discussion of such combinations of all the body characters which determine the anatomical constitution of an individual in a given population, particularly in so far as these characters are in the limits of certain norms. Lubosch discusses the different traits characterizing the individual (variability) and the interaction of these traits in the individuality (combination and correlation), the appearance of single characters (morphological basis, of heredity) and he finally formulates a program for the work to be done in the new field of individual anatomy.

G. Mittasch, in his chapter on "Individual pathology and nosology" deals with the influence of the individual constitution upon the different factors producing pathological conditions. F. Schiff, in his paper on "Person and infection" gives a detailed and highly interesting account of the interrelations between individuality and infection. He critically reviews the interaction between age, sex, genetic constitution, nourishment, pregnancy, menstruation, season, climate, social conditions and so on, on the one side and the infection, the course of the disease, the mortality and so on, on the other side.

The chapter on "Constitution and Race" by V. Lebzelter presents a detailed review of the different constitutional characters typical for the different races and groups of races. H. Ullman's contribution on "The Length of Life of Man" concludes the first volume. This is the first really complete presentation of all the known data concerning the length of life of man and the factors influencing it.

On the whole, it seems to me, that among the literary medical production of recent years the book by Brugsch and Lewy will prove to be the most valuable one for geneticists. The contributions by Lubosch, Schiff, Lebzelter and Ullmann are particularly stimulating for those interested in general problems of heredity.

Walter Landauer.

An Error in the September Journal

THROUGH an error in proof-reading the symbol Σ was added in two places where it did not belong in the article on "Twin and Triplet Ratios." Line 14, column 2, page 290, should read "of twin pregnancies, a function of", and line 7, column 2, page 293, should read "twin pregnancies and is a function." The symbol Σ in the preceding formulae was obviously used in its widely accepted meaning in statistics, indicating the sum of the following quantity.

HERITABLE CHARACTERS OF MAIZE

XXX. Weak Tassel*

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WEAK tassel is the designation given to abnormal maize plants characterized by poorly developed tassels and ears. The abnormality first appeared in 1925 in two closely related progenies of a pedigreed stock of sweet corn being bred for resistance to the corn ear worm.

The plants appear to be normal in all respects except the tassel and ear. The tassel branches and central spikes are very slender and drooping whereas in the normal plants they are erect. The base of the branches and central spike develop few spikelets, and these widely separated, but the number increases toward the tips. Even at the tips of branches, however, spikelets are not as numerous as in the branches of normal tassels.

Although the spikelets appeared normal the anthers failed to shed pollen whereas the tassels of normal sibs shed pollen freely.

Several ears were bagged for pollinations but the silks failed to appear. After waiting a few days for the silks, the tips of the husks were cut back several inches before the ear was found. The cobs were very much smaller than those of normal sister plants and in most instances these abnormal ears produced less than 25 silks.

The silks on the abnormal ears were prolonged less than 5 cm. over the tip of the cob whereas the husks extended 10 to 12 cm. beyond the tip of the ear. The husks were cut back to the silks and an abundance of fresh pollen from normal plants in the same row and sister progenies was applied. Three ears were obtained, one with 1 seed, one with 2 seeds, and the third with 10 poorly developed seeds. These seeds failed to germinate when planted in 1926.

In Table I a few measurements are given showing the contrast between normal and weak tassels.

Figure 25 shows a tassel and ear from a "weak tassel" plant. (Reduced about one-third). This picture was taken at the time the normal plants in the row were being pollinated and shows the extent of development of the silks.

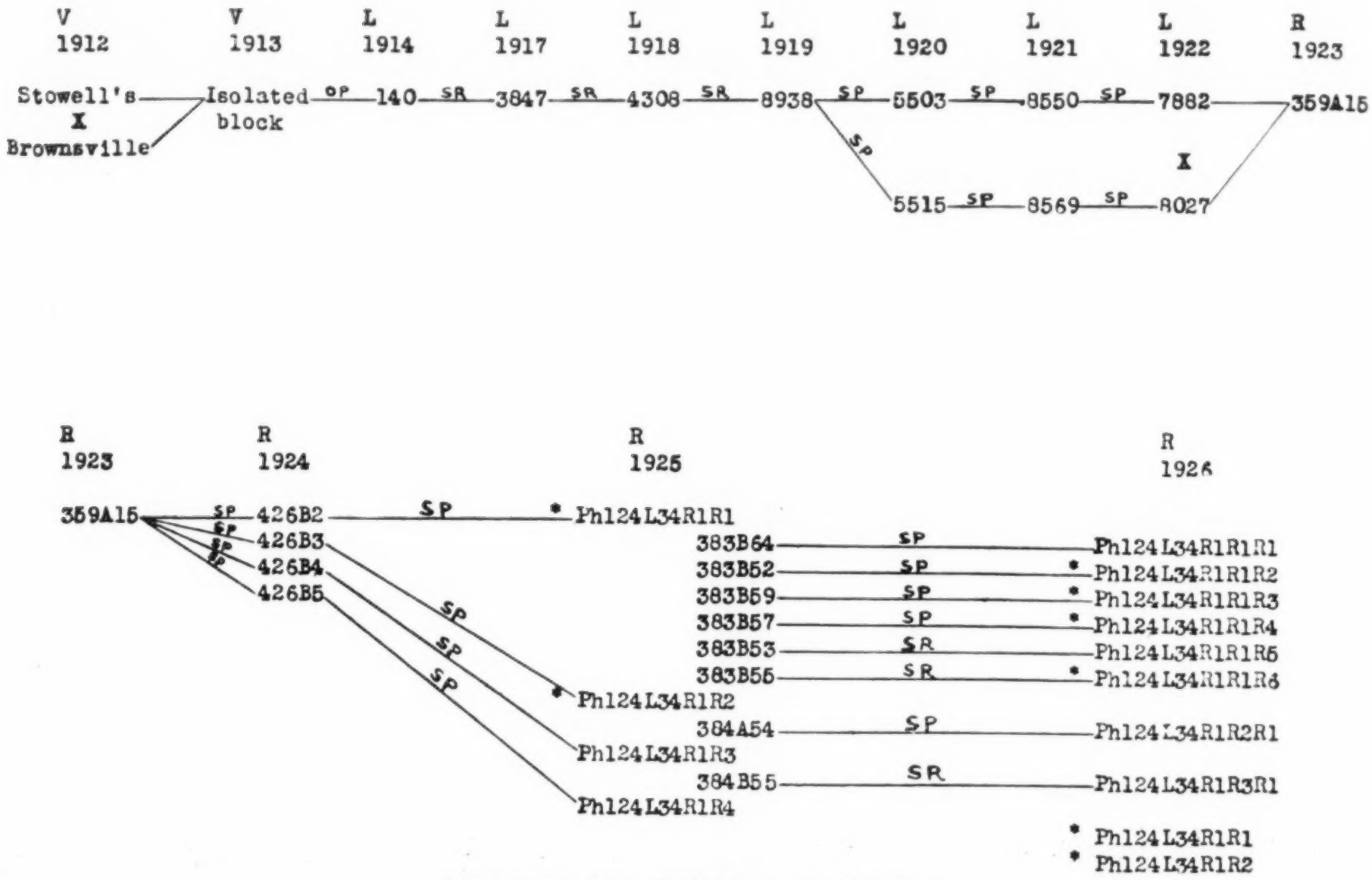
Figure 26 shows normal and weak tassel at the time pollen was being shed. Anthers can be seen extruded from the spikelets of the normal tassel on the left while the glumes on the weak tassel have failed to open. (Reduced about two-thirds).

Figure 27 shows normal ear and an ear from a weak tassel plant at time of maturity. (Natural size).

The weak tassel plants first noted in 1925 appeared in the tenth generation of a strain being propagated for worm resistance. This stock of seed had been maintained over a period of ten years by controlled pollinations. The pedigree of this stock is given in Figure 24. By means of Wright's coefficient of inbreeding it is found that the parent of the progenies segregating for "weak

*Since this paper was submitted Woodworth[3] and Jones[2] have published descriptions of similar variations. Although the resemblance of weak tassels is very close to "barren sterile" and the abnormality figured by Jones, it will be noted that the staminate spikelets on both Jones' and Woodworth's specimens are normally spaced. In the weak tassel variation the inflorescence is characterized by distinctly drooping branches with widely separated spikelets.

A difference of appearance of this nature offers no assurance that the three variations are not genetically identical and it will remain for breeding tests to establish their independence. The publication of this note may be justified as calling attention to the possible existence of several distinct sorts of complete sterility similar to Emerson's "Tassel seed" series.



ORIGIN OF "WEAK TASSEL"

Figure 24

Pedigree of stock in which the abnormality "weak tassel" appeared. Progenies marked with asterisk are the ones in which the abnormality appeared. R-1923 is repeated for convenience in making the graph. OP—open pollinated; SR—pollen from plant in same row as female; SP—self pollinated.

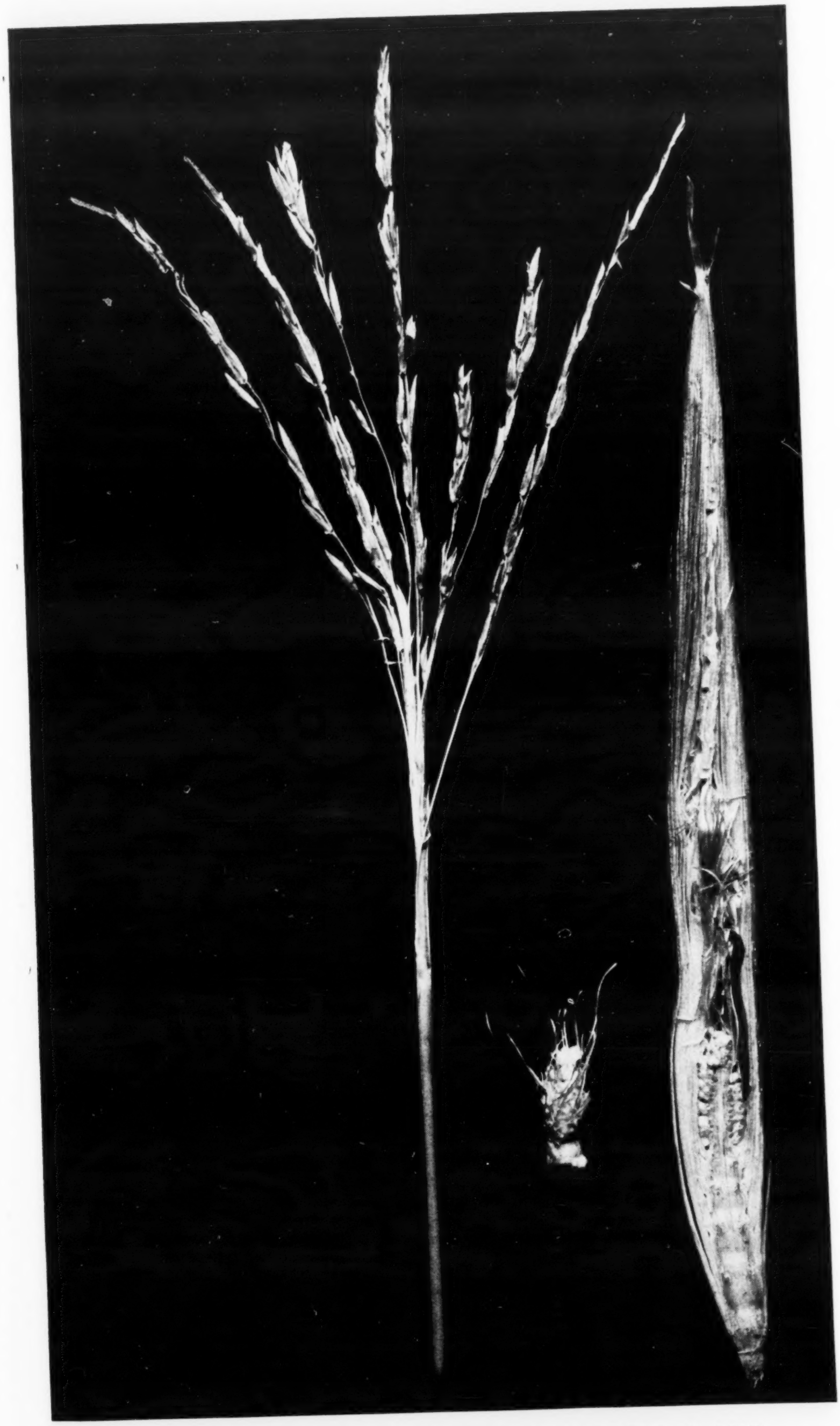
tassel" had a coefficient of inbreeding of 90 per cent.

Experiments were begun in 1912 with the idea of securing a type of corn immune to the attacks of the corn ear worm (*Chloridea obsoleta* Fab.).

Four protective characters were in mind at the beginning of the experiment: (1) The distance which the husks extend beyond the tip of the ear, with the idea that larvae frequently gain access to the ear by entering at the tip of the shoot and eating their way down the silks. It would obviously be advantageous to increase the distance they must travel. (2) The thickness of the husk covering. Many ears are found with perforations through the husks, and a thicker covering might be expected to hinder the invasion of the larvae from this direction. (3) The texture of the husks. In most sweet varieties the husks are relatively soft and smooth, while in field varieties, especially those from the Tropics, the husks are firm and harsh. The outer husks of some varieties are covered with firm spicules, providing a surface almost as silicious as sandpaper. This character might be expected to deter the insects from eating their way to the ear through the husks. (4) Husk leaves. It was thought that ears without husk leaves might be less attractive to moths.[1]

In 1912 Mr. John H. Kinsler, at Victoria, Texas, made various crosses between three commercial varieties of sweet corn, Stowell's Evergreen, Early Evergreen, and Early Cory, and two varieties of field corn, Brownsville and Marrainto. Brownsville is a selected strain of the variety in which Mr. O. F. Cook had first observed the worm resistance; Marrainto is a variety from northern Mexico, with rather thicker and harsher husks than those of Brownsville. These also extend well beyond the ear.

In selecting plants for pollination preference was given to those with long husks and few husk leaves; but other types were also pollinated, including a few that were distinctly inferior with respect to the characters thought to denote worm resistance.



TASSEL AND EAR FROM "WEAK TASSEL" PLANT

Figure 25

The ear remnant partially enclosed in husks shows normal ears. This abnormality appeared in the tenth generation of a stock being bred for worm resistance. In the progenies in which it has appeared the percentage of weak tassel plants closely approximated the 25 per cent expected for a simple recessive character.

TASSELS FROM NORMAL AND "WEAK TASSEL" PLANTS FROM THE SAME PROGENY

Figure 26

It will be noticed that the anthers on the normal tassel (left) are extruded whereas the spikelets of the abnormal plants never have opened. The weak tassel represents a less extreme example of this character than is found on the majority of plants of this type and the normal tassel is somewhat below the average.

PLANTS FROM THE SAME PROGENY

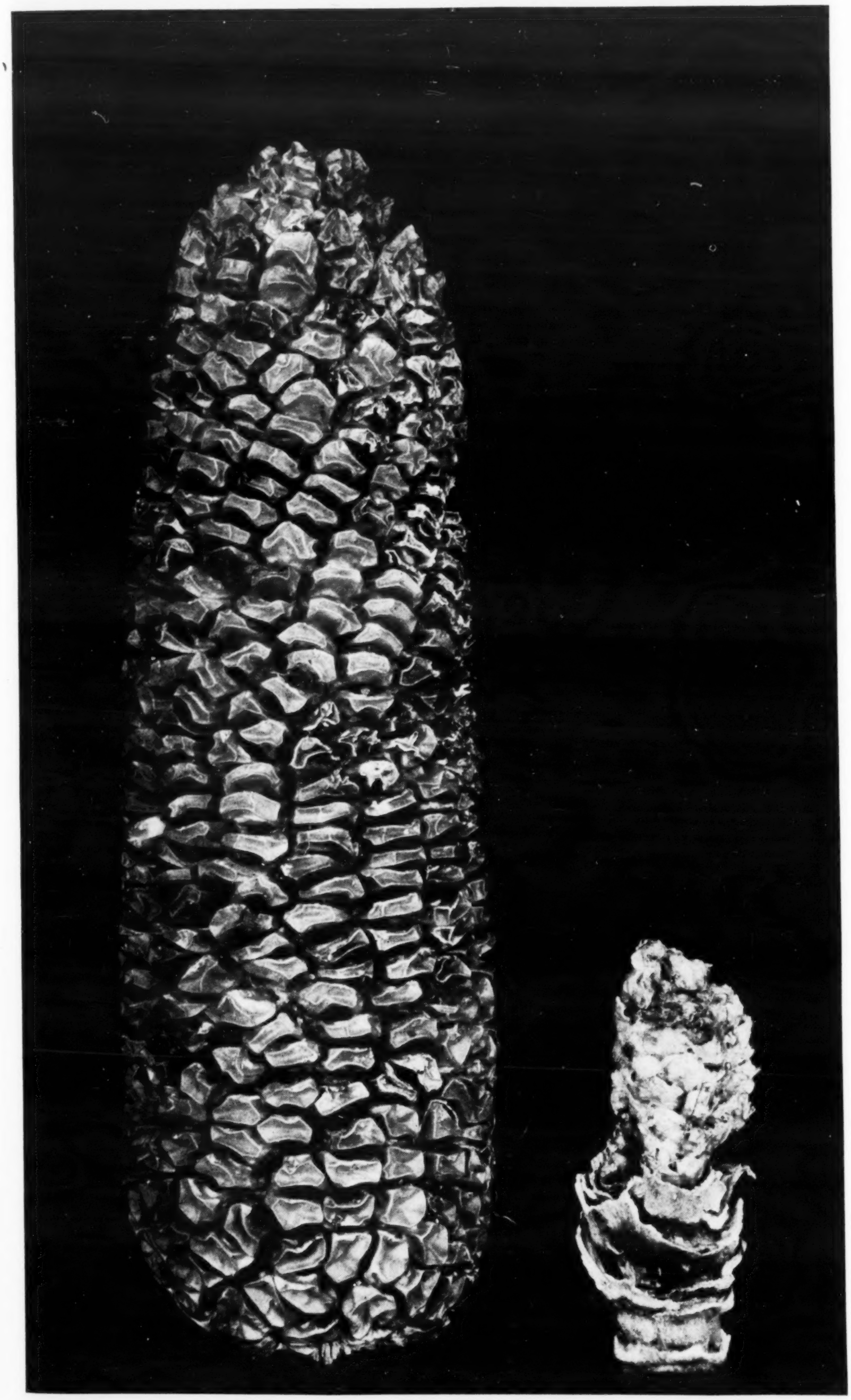


Figure 26

It will be noticed that the anthers on the normal tassel (left) are extruded whereas the spikelets of the abnormal plants never have opened. The weak tassel represents a less extreme example of this character than is found on the majority of plants of this type and the normal tassel is somewhat below the average.

TASSELS FROM NORMAL AND "WEAK TASSEL" PLANTS

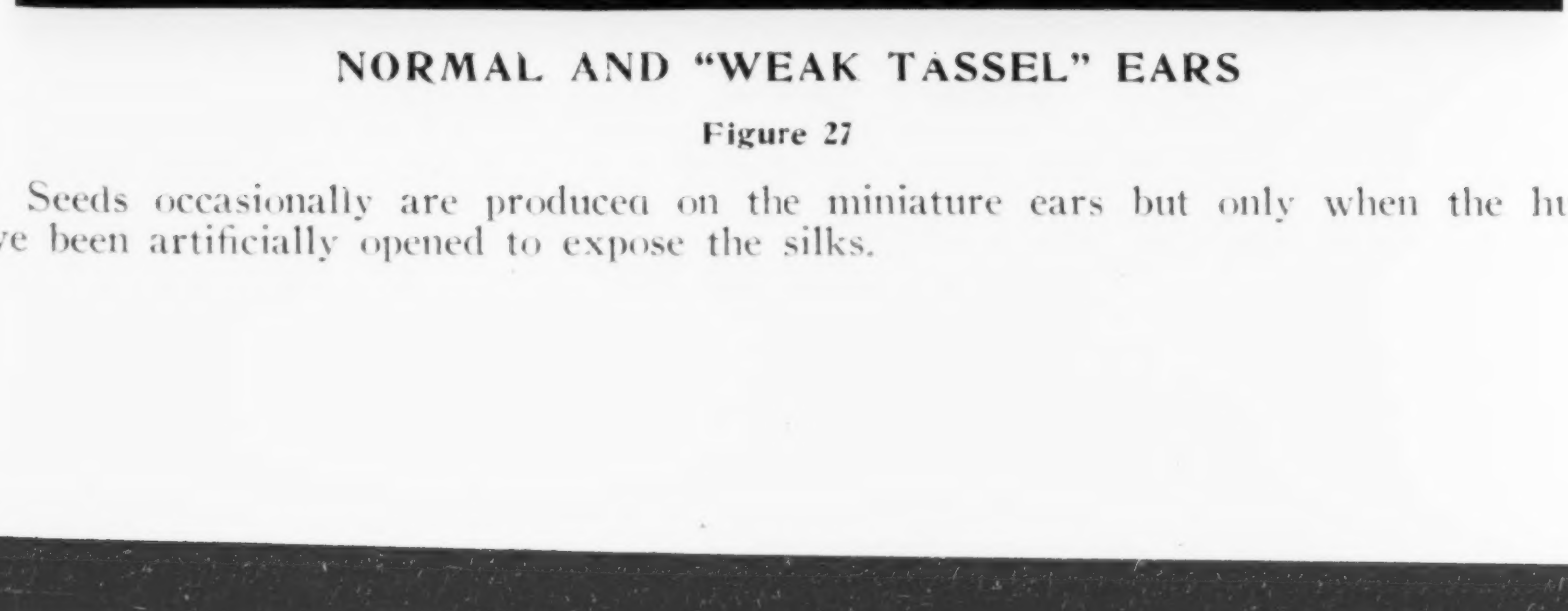


Figure 27

NORMAL AND "WEAK TASSEL" EARS

Seeds occasionally are produced on the miniature ears but only when the husks have been artificially opened to expose the silks.

The selection of ears each year to continue the experiment was made from ears showing the best resistance to the corn ear worm. Prolongation of husk beyond the tip of the ear was a factor receiving consideration in this selection. The husks on the reduced ears compare favorably in length with the husks on normal ears. It may be of some significance that these plants with weak tassels and reduced ears appeared in a stock continuously selected for husk prolongation since the poorly developed ears have prolongations ideal for worm resistance.

In 1924, four self pollinated ears were obtained in the progeny designated Ph124L34R1—and in 1925 these four progenies were grown at Arlington, Virginia. The two progenies in which abnormal plants appeared were classified as follows:

Progeny Ph124L34R1R1 had 37 normal and 8 with weak tassels.

Progeny Ph124L34R1R2 had 22 normal and 10 with weak tassels.

In the combined progenies there were $23.4 \pm 3.2\%$ plants of the weak tassel type, a close approximation of the 25% expected for a simple recessive character.

The other progenies, Ph124L34R1R3 and Ph124L34R1R4 produced normal plants only.

In 1926 there were six progenies planted of Ph124L34R1R1, one of Ph124L34R1R2, and one Ph124L34-R1R3, and plantings were made again from the remnants of Ph124L34R1R1 and Ph124L34R1R2.

The progenies that segregated for "weak tassel" gave 125 normal and 37 weak tassel or $22.8 \pm 2.2\%$ weak tassel. The percentage of weak tassel plants in the second year of this abnormality also closely approximates the 25% expected for a simple recessive character, and indicates that this abnormality is inherited as a simple Mendelian character.

TABLE I—Contrast between Normal and "Weak Tassel"

Type of plant.	Length of branching space.	Length of central spike.	Length of longest tassel branch.	Number of tassel branches.	Number of secondary branches on longest tassel branch.
Normal	14.73±.24	19.33±.25	19.91±.23	27.05±.23	1.34±.08
Weak Tassel	9.64±.26	12.42±.79	18.25±.76	9.36±.30	1.14±.03

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